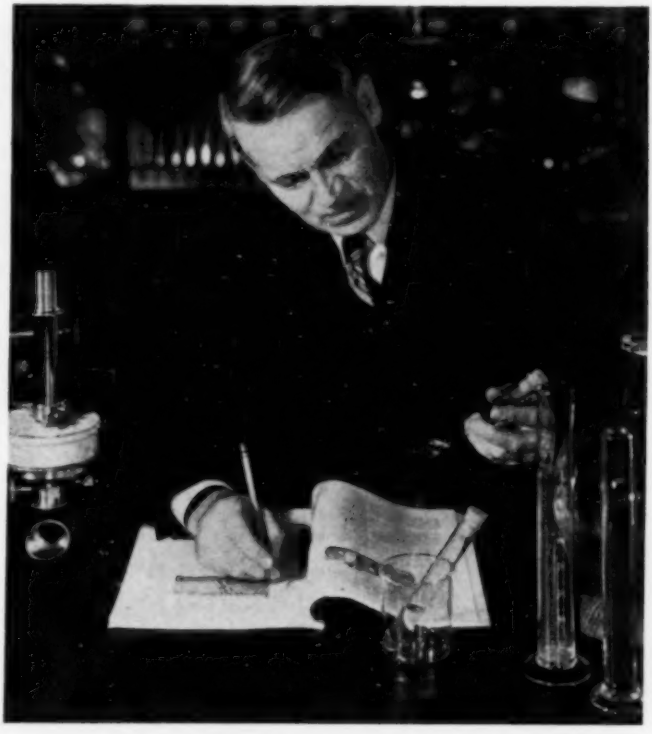
THE CHEMIST

JUNE 1931 VOLUME XXVIII No. 6



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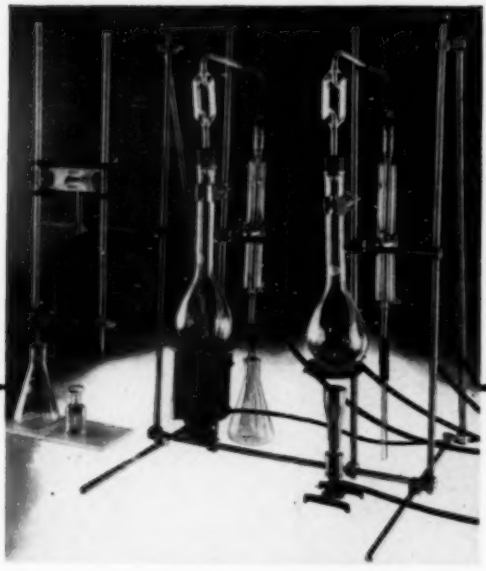

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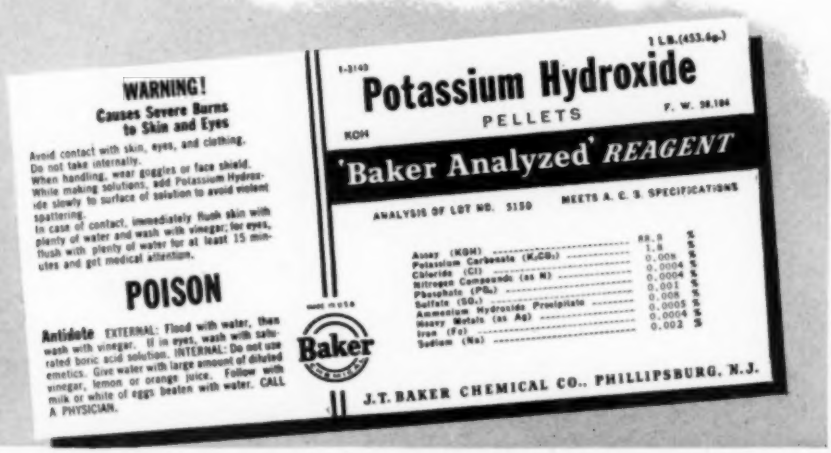
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SCHEDULED FOR EARLY ISSUES

Annual Reports
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Opportunities in Chemistry, Dr. M. J. Kelley, F.A.I.C.
Award of N.Y. Honor Scroll, to Dr. R. E. Kirk, F.A.I.C.
The Chemist as a Human Being, Dr. R. E. Kirk, F.A.I.C.
The Cooperative Spirit, Dr. Clyde E. Williams.
Presentation of Ohio Award to Dr. Clyde E. Williams

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It was not possible to include all of the fine papers presented at the AIC Annual Meeting, May 9th to 11th, Niagara Falls, Ont., in this issue of THE CHEMIST. Therefore it was necessary to schedule the following papers, presented on the final day of the meeting, for the July issue:

Emulsion Paints, by Donald A. Kohr, Jr.
Ethics and Evolution, by Jerome Alexander, Hon. AIC.
The Responsibility of the Chemist to his Profession, by Dr. Harry L. Fisher, Hon. AIC.
The Chemist and World Federal Government, by Dr. Charles C. Price, F.A.I.C.
The Chemist and His Neighbors, by James G. Vail, F.A.I.C.
Responsibilities of the Chemist for Continued Self-education, by Dr. Raymond E. Kirk, F.A.I.C.
Benzene from Petroleum—How and How Much, by Dr. Gustav Egloff, Hon. AIC.
Some Recent Developments in Testing Germicides, by Dr. Emil G. Klarmann, F.A.I.C.
Progress in Research on Cosmetics, by Maison G. de Navarre, F.A.I.C.
Progress in Peroxides, Dr. H. O. Kauffmann, F.A.I.C., & Dr. Frank P. Greenspan.

Departmental material omitted or curtailed in this issue of THE CHEMIST will be restored in later issues. Additional articles scheduled for future issues of THE CHEMIST are listed on page 204.

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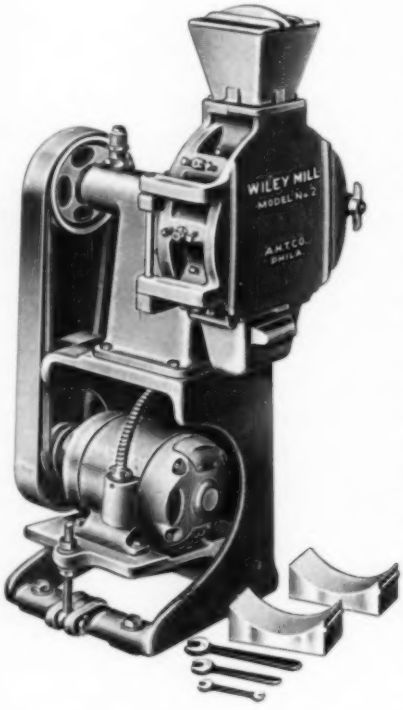

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EDITORIAL

The Stimulus of AIC Meetings

L. F. Hoyt, F.A.I.C.

National Aniline Division, Allied Chemical & Dye Corporation, Buffalo, N.Y.

It has been our privilege to attend the past three Annual Meetings of THE AMERICAN INSTITUTE OF CHEMISTS at Chicago, New York, and Niagara Falls, Ontario. It is no exaggeration to say that these meetings have yielded greater personal satisfaction and rewards than any other series of scientific meetings which we have attended in over thirty-five years of activity in the profession of chemistry.

From the standpoint both of variety of topics discussed by eminent speakers, who show what the chemist is doing, how he is doing it, and what he can do in the future, as well as the opportunities offered to meet with old friends and to make new ones, these AIC gatherings have been most enjoyable, inspirational, and profitable.

The New York meeting of May, 1950, was, perhaps, outstanding for its series of surveys of progress in various fields of chemical industry at the Mid-century and for its "predictions of things to come." One feels a certain pride in being a member of a profession which has made such strides in a half-century and which promises even greater achievements in the years ahead.

It is a privilege also to be present when the INSTITUTE bestows its Gold Medal on such distinguished chemists and old friends as Drs. Warren K. Lewis, Walter J. Murphy, and Harry N. Holmes, and to hear their inspiring addresses of acceptance.

Having had a share in making arrangements for the 1951 Annual Meeting, we can testify that such meetings require a lot of hard work, but there is a lot of satisfaction, too, in working with associates in the local chapter on such a project, and to see the meeting "come alive" as the various activities dovetail successfully.

Many of those who have attended these Annual Meetings undoubtedly share our feeling that a special and unique stimulus, which remains to inspire us to new achievements, is provided by the type of meeting held by the INSTITUTE.

Appointed: Francis J. Curtis, F.A.I.C., as assistant administrator to head the Chemical Rubber and Forest Products Bureau of the National Production Authority. He is on leave as vice president and director of the Monsanto Chemical Company.

Our experts are students

SOME of our men have been with us many long years. It would be safe to assume that they know as much about our kind of chemicals as anyone in the world—perhaps more.

Yet their business lives—and a good part of their should-be leisure hours—are still devoted to learning more. They may be seeking new and better ways to maintain the high quality of our products. Perhaps their studies are directed to new uses of our chemicals and their derivatives.

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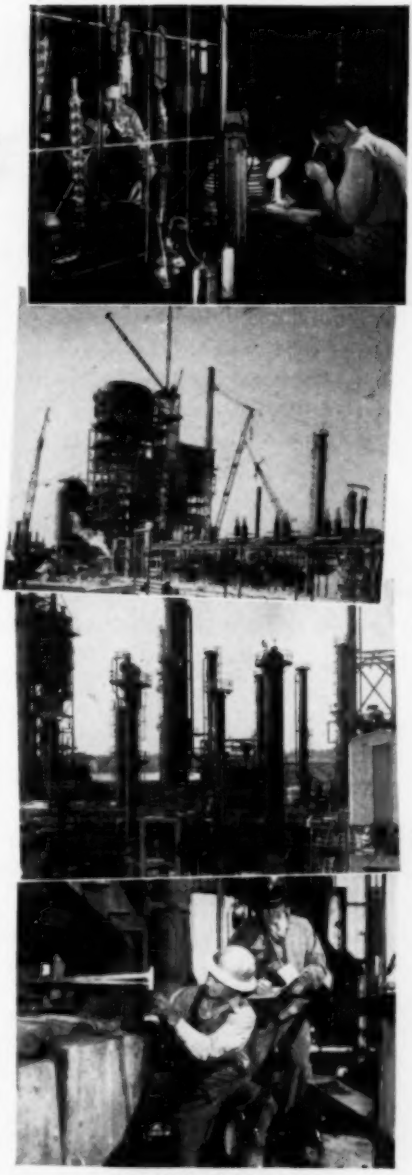

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Some Problems—Solved and Unsolved

Dr. Harry N. Holmes, Hon. AIC.

Professor Emeritus, Oberlin College, Oberlin, Ohio.

(Medal Acceptance Address at the A.I.C. Annual Meeting, May 11, 1951)

OUR American way of life is threatened. If we are to remain strong enough to insure world peace we must make democracy work.

Making it work requires the best talents and efforts of all groups, among them the chemists and chemical engineers. Like all groups the chemists are confronted with problems of national importance, some familiar to the general public and others discernible only to scientists of long vision. Success in detecting and relieving the strains on our economy may well result in the defeat of Communism as a world menace.

The problem most readily recognized by the public is that of liquid fuels. We are encouraged by the American Petroleum Institute's report that our proved reserves of petroleum now total nearly 30 billion barrels with gas reserves equivalent to 3 billion more. Better yet, 3 billion barrels were added to reserves in 1950 at the same time that we used a little more than 2 billion.

However disaster lurks around the corner. If Russia takes over Iran and Iraq, perhaps Arabia too, Venezuelan oil will have to be diverted to our European Allies. Furthermore, Russian submarines might cut off the flow from South America to Europe. Wisdom calls for rapid development of the synthesis of liquid fuels from natural gas and coal. We know how, thanks to German research, and we are starting production from natural gas. The economics of coal-to-liquid fuels is the question now but during a full-scale war economics is thrown out of the window.

The University of Minnesota has shown that lignite, found in unlimited quantities in the Dakotas, can serve as a practical source of liquid fuels, principally diesel and other fuel oils. The Bureau of Mines is greatly encouraged by their pilot plant results with oil shale, although many petroleum chemists doubt the economic future of such an industry. The enormous deposits in Colorado justify research with this source. The Alberta tar sands may become useful at some distant date.

Conservation, so splendidly practiced by the petroleum industry, strengthens the nation. It even calls for encouragement of coal-dust turbines for locomotives. Eight railroads have been supporting research in this field with very encouraging results.

Government restrictions on the use of strategic materials, a long list,

is galling at times but necessary at present. In a war book I wrote in 1942 ("Strategic Materials and National Strength"), I urged that stockpiling should be begun at once, for in peace the public becomes apathetic. Some business men feared that an economy-minded Congress might dump stored material and upset prices. Stockpiling was slow to start but it has official and financial support now. When large enough, stockpiles of rubber, tin, manganese, etc., serve as a partial guarantee of national safety and as a price-stabilizing influence. We remember the outrageous prices of East Indian rubber demanded during President Hoover's Administration and Japan's gouging with Formosan camphor. Those countries overreached themselves for now our synthetic rubbers and camphor give us a high degree of independence. Clearly substitutes for strategic materials is the answer to many of our problems. Add to this, research on the practical utilization of our low-grade ores (manganese, iron, etc.) and price encouragement for certain crops (linseed oil when Peron upped the price of flaxseed) and we will greatly strengthen our industrial and military power.

Tin

Tin offers a tough problem, unsolved as yet. To be sure we learned how to put a thinner coat on sheet steel for cans, and we can use aluminum (or can we?) in collapsible tubes, even plastics; and civilian food can be put in glass jars, but what substitute is there for tin in brass and bronze and a few other alloys? World War II forced a reluctant ordnance bureau to use sheet steel (instead of the preferred brass) in certain shells. Perhaps the recently reported discovery of tin ore in Alabama will help. In the past seventy years we spent $3,000,000 searching for domestic tin ores and got only a little in Alaska.

Iron

There is occasion for alarm over the rapidly-diminishing supply of rich Lake Superior iron ore. This situation has forced very extensive research by steel and ore companies on the beneficiation of low-grade taconite ores, also found in vast quantity in the Lake Superior Area. Our next hope is the great Labrador-Quebec ore body. Development, now in progress, includes a long railroad to a port on the St. Lawrence River. Rail haul to our steel cities costs more than sea freight to Baltimore and other Atlantic ports. Does this mean that the industry must be moved to the sea? Probably not for there is new vigor in the drive to put locks and dams on the St. Lawrence, making Cleveland and Chicago seaports. Freighters to Baltimore could be menaced by hostile submarines. This applies, too, to imports of the vast Venezuelan ore bed. American steel companies are taking that risk

and actively pushing production in Venezuela.

Aluminum

It seems strange to find restrictions on aluminum, but that industry can expand as fast as the Government releases electric power to the aluminum companies. "Alcoa" promises 500,000 tons, in 1952, and of course we can always draw on Canada for more.

Titanium

The spotlight of restrictions is now thrown on the Periodic Table. Titanium is not rare, in fact it is the ninth most common element, but as a metal it is new, and desired for jet-engines (Ti-Cr alloy). Sixty per cent as heavy as steel but just as strong, ductile, with a very high melting point and great corrosion resistance—titanium, at least in alloys, is a metal of promise. Niobium alloys, too, are demanded for jet engines and gas turbines. Zirconium, with a low neutron absorption, is valuable in atomic piles.

Manganese

Manganese, vital to the steel industry, has long been a subject of concern. We have only low-grade ores, so we buy from Russia (but not now), India, and Brazil. Now comes our Bureau of Mines with a process for recovery of a possible 300,000 tons a year from blast furnace slag.

Crystals

Such small items as crystals would not seem to be very strategic but they are. Synthetic sapphires for bearings in the many instruments on planes and ships, and for watches, are vital, yet in World War II it took us many months to learn how to use the Verneuil process of manufacture—and to bore near-perfect holes in the gems. Synthetic quartz and mica crystals for the electrical industry and electronics are good insurance against failure of foreign supplies.

Fluorine

Fluorspar, we are told, will be exhausted in twenty years. Then how will the aluminum industry make artificial cryolite, double fluorides of aluminum and sodium, as the electrolytic bath? The answer is to recover more fluorine, as hydrogen fluoride, from phosphate rock. It is a nuisance now, in the rock. Furthermore, petroleum refiners use an increasing amount of anhydrous HF as a catalyst.

Synthetic Rubber

The triumph of synthetic rubber is too well-known to dwell upon here but it is interesting to note that production for 1951 is estimated at 1,000,000 tons. Rubber roads pose the problem of getting enough natural rubber for the thin rubber-asphalt surface. Tests in Holland have been successful and now there is a demand for tests here. Anti-skid, cheaper to maintain, they have possibilities, especially in tonnage of rubber. So far

we do not know if synthetic rubber would serve as well.

Farm Products

But for scientists, American farmers using the methods of the last century could not feed 150,000,000 hungry mouths. In 1900 one farm laborer fed eight people; in 1948 he fed fourteen or fifteen, thanks to the tractor, liquid fuels, insecticides and fungicides, fertilizers, weed killers, electric power, better-bred stock and plants. Anhydrous ammonia now accounts for 30 per cent of all nitrogen fertilizers, while in 1947 it accounted for 3 per cent. Vast areas in the dry Southwest, now covered with mesquite and sage, can be cleared rather cheaply by using weed killers. The sparse grass can then get a better chance to grow. The farmer is said to give his stock a more scientific diet than most people get. It pays to add growth factors and vitamin B-12 to the diet of hogs and poultry, to get more meat in less time.

The Protein Problem

Yet with all this tremendous meat production, we face a future problem of getting enough animal protein for optimum health. Yeast as a cheap nitrogenous cattle food would help conserve pasture and grain. Urea does this already to a limited extent. It can substitute for one-third of cattle protein-food. In the distant future we may rely upon *chlorella algae* which can produce 50 per cent protein (dry weight) or, with different nutrients, 85 per cent fat.

The Use of Science

Modern wars are highly technical, scientific, in their weapons, yet final decisions as to use of products of the laboratory are in the hands of men educated at West Point, Annapolis and other military schools. They are not scientists. Professor Ryerson's suggestion that two years specialized military training at West Point or Annapolis should follow four years of college with a major in science, is thought-provoking.

Water

The problem of water supply in vast areas, water pollution and SMOG press upon us. Industry cooperates, and must, for tough legislation threatens. An interesting minor item in this connection comes from the great tonnage of synthetic detergents now used. They interfere with proper settling of solids in sewage disposal plants.

Technical Aid

The problem of the spread of Communism is closely related to the technical aid we give to poorer countries. When starvation threatens, Communism seems to the ignorant to be the least of all evils. The Rockefeller Foundation has for years attacked epidemics of disease in all parts of the world. Now our Government is doing this and is also trying to improve agriculture abroad. Success with the foot-and-mouth disease of

—*Chemical & Engineering News*

Dr. Harry N. Holmes being presented the AIC Gold Medal by Dr. Harry L. Fisher. AIC President L. H. Flett is on the right.

cattle helped Mexico and helped us. So did hybrid corn. Through the wise efforts of Dr. A. L. Elder, F.A.I.C., of Corn Products, hybrid corn has been introduced into Italy and is rapidly becoming popular.

In Arabia, American oil companies are making money but at the same time they are building for their native workers better houses, schools, hospitals, and teaching at least the rudiments of sanitation and agriculture. The world gains by such a broad view of good business.

Big Business

I must not omit the problem of corporation size. Our Government attacks Big Business as bad and at the same time selects the duPont giant as competent (because of its great size) to build the $600,000,000 plant for production of materials for the H-bomb. Other gigantic corporations are asked to save the nation because small corporations simply do not have the requisite resources. New and useful products are in use now because some giant company could risk $30,000,000 in research and development. Corporations of the size the Government affects to admire could not risk such a gamble.

As to the outlook, give me optimism, because pessimism discourages initiative.

Introducing Dr. Harry N. Holmes

Dr. J. A. Cambell

Associate Professor of Chemistry, Oberlin College, Oberlin, Ohio.

(Introduction of the Medalist, presented at the AIC Medal Banquet May 11, 1951.)

I SHOULD like to introduce to you an artist, A very young artist some six years of age, and yet an artist who has already organized a show for the Chicago 1950 meeting of the American Chemical Society and is fostering another one at present in connection with the Fall 1951 Meeting of the Society. His own paintings in oil stood at the top of the list in Chicago in public acclaim and a repeat in New York may be looked for.

I should like to introduce to you a gardener *par excellence*. A trip through the village of Oberlin will immediately reveal his handiwork in the best kept lawn and borders in the town. He is blest not only with a green thumb, but evidently with eight green fingers and another thumb as well.

I should like to introduce to you a golfer—one of the very few golfers in the world whose score for eighteen holes is approximated by his age. In Class A competition recently in Oberlin he has won entry into the semi-final round where honors were even as the round drew to a close. The last part of the course lay over a creek and our guest, teeing off first, had the misfortune to send his shot into the water. The resulting gloom was momentarily relieved when his opponent's tee shot also landed in the creek, only to be intensified when the ball reappeared on the other side and hopped to the green as it bounced off a rock in the creek bottom. So you see that adversity has appeared, as well as success, in our honored guest's experiences.

I should like to introduce a researcher—well known for his work in the field of colloids, in silica gels, and in vitamin isolation and use. His versatility in research and inspiration with respect to research subjects may be epitomized by the fact that the acquisition of a marrow spoon (for removing marrow politely from bones without the usual loud sucking noise) aroused his interest in the composition of the marrow and led to his isolation from marrow of several new substances.

I should like to introduce an outstanding author—whose texts have been as widely used as any in the field of general chemistry and have thus influenced over half a million students in their understanding of the subject. His advanced books on colloids and his popular writings such as "Out of

the Test Tube" have had correspondingly great acceptance in their own fields.

I should like to introduce a truly exceptional teacher. One of his best friends once told me, "That man would hang by his heels from the chandelier if he thought it was the best way of making a point for his students". Yet no one has ever been able to make a monkey out of the man we honor. His teaching was always clear, well illustrated, and dramatically presented. On sleepy spring days, dreamy students were called to the lecture desk and given active parts in the performance of demonstrations. He is well remembered by one of his pupils for his telling demonstration of the effectiveness of ammonia as a sleep inhibitor when introduced under the nostrils of a somnolent student. The great effectiveness of the teaching of this man is proven by the fact that during the ten-year span from 1935-45, over one per cent of the Ph.D.'s in chemistry granted in this country were given to his former students, and that more of his Oberlin College students went on to take this advanced degree than those of any other college in the country.

All these—artist, gardener, golfer, researcher, writer, teacher—are one man. Yet one of his greatest personal satisfactions may well come from another facet, his family; as close knit, yet friendly and hospitable as any.

—*Chemical & Engineering News*

Dr. J. A. Campbell and Dr. Donald B. Kohr, Jr., Speakers for the Medalist on the occasion of the presentation of the AIC Gold Medal to Dr. Holmes.

His wife and his two sons are justly proud of him, and he of them in return. Their home in Oberlin is well known for its warm greeting and atmosphere of conviviality. The accomplishments of the sons reflect again the inspiration of the father, because one is professor of English at Pomona College, and the other, now holding a post doctoral research instructorship at the University of Illinois, has just been asked to come to Oberlin College to teach, and to inspire the present generation of students in chemistry, the field so long and so ably filled by our medalist, Harry Nicholls Holmes.

Personal Tribute to Dr. Holmes

Donald A. Kohr, Jr.

Technical Director, Institutional and Special Products, Sherwin-Williams Co., Chicago, Illinois.

(Presented at the AIC Medal Banquet, May 11, 1951)

THROUGH circumstances beyond his control, Mr. Alden Emery was unable to be at this Annual Meeting to pay his personal tribute, as a former student, to Dr. Holmes. As Mr. Emery, I, too, was once a student of Dr. Holmes. To all of his students those all too short hours, spent in the class room and laboratory with him, stand out today, as cherished memories, which we have lived with, and carried with us, down through the years.

We came under his influence, first, as confused freshmen. His ability to make the chemistry he loves come alive, and to pass that interest on to us, his students, is, to our way of thinking, his most outstanding accomplishment in a life which has been one accomplishment after another as a student, teacher, scientist, author, speaker, administrator, and man of letters.

I would like to take the following paragraphs from the introduction Mr. Alden Emery had prepared for this meeting, from which I quote:

"And so I came under the magic of Holmes' teaching methods, the charms of the man, the lucidity of his explanations, the ability to make chemistry live. It was the most vital teaching I have ever known. I can not help but believe that many chemists would be following other pursuits today if they had not been led so effectively through these intricacies of a strange land. He knew the easiest pathways up some of the rugged mountains of unfamiliar theory. He knew the vantage point on the summit from which to show the promised land, and, having guided the tenderfoot along roads he could traverse, and having shown him some of the beauties which lay ahead, he stepped aside. The terrain became rougher and the guides less experienced but Holmes had made explorers out of many of his tourists.

"When shown those vistas of varying kinds we saw the obvious, but Holmes caught glimpses from time to time of something half hidden from our view, something he wanted to explore. It is this, in my opinion, which has made his scientific work so diversified, a natural outgrowth of the opening of broad horizons to the neophyte. In his efforts to broaden us, he broadened himself."

Dr. Holmes became the head of the Oberlin College Chemistry Department at an early age. He built the department to that high position which it occupies today in academic, business, and lay circles. The department mirrors the personality of the man we honor tonight. Through the years industry gave him many opportunities to become a chemical executive. Universities offered him the opportunity to head their Chemistry Departments. He turned these opportunities aside to concentrate on passing along his love and faith, in chemistry, to his students.

It has been a pleasure and an honor to share in a small way in the introduction of Dr. Harry Nicholls Holmes, worshipped by his students, beloved by his associates, honored by his fellow chemists, my teacher, and the inspiration and driving force behind my work in emulsion paint chemistry.

Citation

Dr. Harry L. Fisher, Hon. AIC.

National Research Council, Washington D.C.

Harry Nicholls Holmes

Friend of young men and old men
Superb and enthusiastic teacher, sharing gladly your knowledge of men and the science of chemistry
Writer of extraordinary textbooks
Painter for personal satisfaction
Hobbiest par excellence
Worker in the societies in which you have been a member; former president of the American Chemical Society
Renowned for human dignity and scientific endeavor

As an old friend and admirer of you and your work, I find it an unusual and very happy opportunity, as chairman of the Jury of Medal Award of THE AMERICAN INSTITUTE OF CHEMISTS, *to present this medal to you, which admits you to the unique company of medal winners to whom your name adds grace and honor.*

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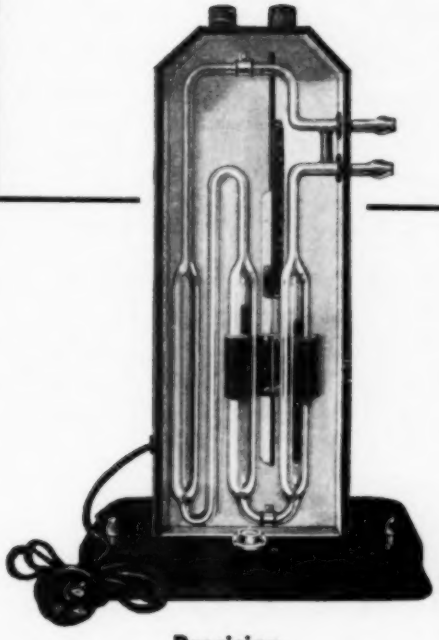

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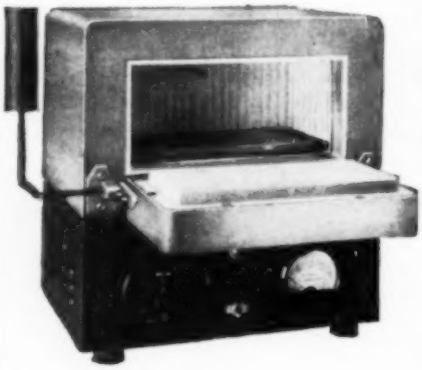

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The Human Element in Research Exploitation

Dr. R. P. Dinsmore, F.A.I.C.

Vice President in Charge of Research and Development, The Goodyear Tire and Rubber Company

(Presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium on "Transforming Results of Research into Production.")

A SUCCESSFUL business is usually conducted according to principles and regulations which are definite and generally understood by those who supervise any important section of its operation. However, every such organization has adopted certain principles and attitudes and has fostered certain skills, unexpressed, unrecorded, but which strongly influence the effective cooperation of its personnel.

This bald statement is inadequate for our purposes and must be amplified. The very fact that these principles, attitudes and skills are not formally recognized, even by many of those that use them, serves to keep them in the background and to minimize the appreciation of their importance. Their effects are frequently attributed to associated factors, such as business experience, technical skill, energy, gift of expression and the like. Nevertheless, the utilization of any group of people for the achievement of worthy objectives must rely for success upon intangible factors of the kind enumerated. There must be a common conviction of sound principles of conduct, an enthusiasm for the objectives pursued, a confidence in the adequacy of the leadership, and an *esprit de corps* which involves, among other things, a belief shared by all members of the organization in the ability and cooperative interest of the rest. Complete destruction of any one of these features will cause the enterprise to fail; damage to one or more will at a minimum reduce effectiveness.

It is hardly necessary to point out that no organization of people, even one selected carefully for similarity of background and mutuality of taste, spontaneously adopts and adheres to the conditions needful for effective action. Rather is it a fact that with necessarily diverse constituents, such as comprise commercial organizations, the achievement of even approximate conformity to the ideal pattern is very difficult. It follows then that successful management of any enterprise is proof in itself that the human requirements have been adequately fulfilled, either by conscious intent or by trial and error.

If these assertions be accepted, a

number of things, which will otherwise be puzzling, become clear. A man, who, after working for others and acquiring a sound technical knowledge of all essential branches of a business, engages in the same type of business for himself. Even with a good location, sound financial backing and familiarity with the market, he fails. In the meantime, another, apparently less favorably equipped, succeeds. The first individual seemed unfortunate in his selection of business associates, who contributed heavily to his failure. The second, on the contrary, appeared to be very fortunate in that respect. The truth is that the first man had no gift for welding his group into an inspired and effective team, while the second overcame his other handicaps by his ability to inspire united effort.

Or, again consider the case, unfortunately common, of a minor executive in a large organization. He has energy, self-confidence and has progressed rapidly in some old established branch of the business. A new line of effort is decided upon which requires the establishment of a new division, the selection of personnel, new equipment, new market approaches. The young executive is put in charge. He starts with energy and enthusiasm. The organization is selected; the work gets under way. Then trouble starts. Orders are misconstrued or neglected. Unexpected delays and difficulties occur. The product is off-quality or fails to meet the requirements of the market. The business goes badly and quarrels break out in the organization regarding responsibility for the difficulties. Obviously the new manager lacks the golden touch needed to transform a group of individualists into a harmonious team. His success as part of a well-oiled and established machine did not fit him for the task of assembling a new one. If he is adaptable and gets sound advice, he may rescue the situation before it is too late. Otherwise, it must be retrieved by other hands.

All of these observations have been made for the general purpose of pointing out the importance of satisfying the human side of business organizations, and that there is frequent failure to recognize the need until new circumstances bring it to light. The comfortable operation of old routines is not automatically attained under new conditions.

The Human Element and New Products

We are now ready to consider the importance of the human element in the process of placing new research developments into successful commercial operation.

However, there is no intention of belittling the role of those tangible factors in new-product commercialization which have been stressed by many experienced executives. These

factors are, essentially, adequate research preparation, adequate piloting, market survey, market testing, patent survey, and adequate organization directed towards synchronized sales service, research, and product improvement. These are well-tested requirements and form the foundation for the entire new development. They cannot be slighted without weakening the whole structure. They are generally known and accepted, however, whereas the more intangible human factors are not as fully appreciated.

There is nothing very new or mysterious in these human factors which will now be considered. Some or all of them may be thought to be mere common-sense precautions. However, before you brush them impatiently aside, think back in your own experience and recall how many difficulties have been caused by the neglect of or insufficient emphasis on one or more of these considerations. It is not necessarily the use of new materials that makes a successful machine, but rather the effective sizing and integration of the parts.

A good farmer not only selects good seed for planting, but he makes an effort to see that it is planted in suitable soil which has been properly prepared. A good research planner will likewise consider that he must not only have a good project, the success of which would offer financial benefits to his company, but he must take steps to determine whether the conditions will be such as to foster its advancement and whether it will get a favorable reception from the management and others that have to deal with it.

For example, a new product which falls into the same category as others with which the organization is familiar and is accustomed to handle, will encounter much less resistance than one which is entirely outside the scope of its experience. In the latter case many questions must be anticipated, discussed and answered satisfactorily, before acceptance can be expected. Such questions may be: does it fit into the overall objectives of the company; will it conflict with or support the sales of present products; can it be manufactured in plant's equipment, and in the general localities now used by the company; can it be appraised, directed and serviced by the skills now available in the organization; are the financial risks within those normally assumed by the company. Answers to these questions should not only be prepared, they should be discussed and favorably received by the organization far ahead of the time when the marketing and production phases are at hand. If the nature of the development requires special skills and separate management, the nature of the requirements and the means of selection of the personnel should be agreed upon well in advance of the

needed action. Such foresight will not only disclose many unconsidered problems, but it will have a valuable psychological effect. It tends to dissipate the natural opposition to the new and relatively unknown and secures instead a cooperative interest in the solution of a common problem. This is especially valuable, when the job is underway and inevitable difficulties arise. There is then a feeling of mutual responsibility and interest in overcoming the obstacles.

Preparatory Research

It has frequently been observed that insufficient preparatory research, either of the scientific or marketing variety, is a costly error, which may prove fatal to the project. Every research manager has had the experience of reporting a timely and favorable result, which was swept out of his hands and on into production by an overenthusiastic management. There is a nice balance to be struck between the need for creating interest and familiarity with a research project as it progresses, and detonation of premature commercial action. The experienced research director will point out the further steps which must be taken to prepare for commercial exploitation, even as he reports the favorable progress of his project.

If, as is frequently the case, a new division of the organization is required to produce and market the new product, it is highly important that the manager and his key men be proficient in inspiring the group with enthusiasm for the project, belief in its ultimate success, and that mutual confidence which constitutes the basis for successful teamwork. In no other kind of work does this kind of human skill yield more outstanding results. It is impossible for a few individuals to anticipate all contingencies and to lay down hard and fast rules of procedure. The very nature of the operation requires constant adaptation, modification and correction until there is a reasonable balance between the method of production, the cost, the sales approach, and the customer demand. Each of these is usually in a state of flux and should be sensitive to the changes in the rest. Intelligent and sensitive response can be brought about only if there is full utilization of the human elements involved in each.

The importance of cooperation which is both broad and deep cannot be overemphasized. By broad, I mean all the way across the business and including the customer, while by deep I mean from the top of the organization down to the individual workman, technician or salesman. There can be no fixed attitude adopted by Production, for example, as is frequently expressed by the admonition to Sales, "This is the product we are going to make. . .Go out and sell it." Nor, conversely, can Sales say arbitrarily, "If we are going to make a profit, we

must have such and such (different) kind of product at this (lower) cost." A truly cooperative organization will give and take, move as far as possible to meet the requirements of the other branches and finally shake things down to the best balance that can be reached. In the final analysis the result may not be as good as would be wished, because of inherent obstacles, but there will be general agreement that it is the best that can be done for the moment and it will be given solid support by all.

Customer Cooperation

I stated that cooperation ought to be broad enough to include the customer. It may sound odd to suggest that he be expected to contribute to the successful market development of a new product. However, every good salesman who is experienced in the introduction of new products knows how important customer cooperation can be. After all no marketing venture can be successful unless it offers a useful service. It is, of course, first necessary to find the customer who needs the service and then to convince him that you can supply it. However, the situation will probably not prove as simple as that, and it is in ironing out complications that the value of customer cooperation is keenly felt.

After a potential customer has been interested in the general features of the product you have to sell, he must be persuaded to try it out. If the first trial does not work satisfactorily, it is of the greatest importance that another trial be made, either with some modification in the product or the method of using it, or both. It is here that the cooperation of the customer is of the highest value. Permission to see the trial firsthand, and willingness to supply advice from his own experience are marks of the truly cooperative customer.

Some people have no intention of being cooperative. It is contrary to their business principles and, if you are certain this is the case, you may as well go elsewhere to work out your problems. However, the best cooperation is attained between people who feel friendly toward one another. Friendship backed up by integrity and mutual confidence is the best possible basis for promoting business. Admitting this, we must likewise admit that oftentimes two people of admirable characteristics do not find any mutual basis for friendship. If you run into a potential customer who does not warm up to your efforts, it may be wise to give one of your associates a chance. Incompatability is a common enough human experience and it should surprise no one to find its effects in the seller-customer relationship. If the customer is worth while, try him with another personality. You need his hearty cooperation and you will get it most

fully with someone toward whom he feels friendly and at ease.

Case Histories

Here are some illustrations of a number of the points which have just been emphasized.

In the early thirties, we brought out a paint resin called Pliolite which was a partly chlorinated natural rubber isomer. It was essentially a solid paint vehicle which had many excellent properties, such as adhesion, flexibility, and chemical resistance. Its chief drawbacks were poor ultra violet resistance and a relatively high cost. However, considerable market acceptance, for specialty uses, was gradually obtained, after intensive field effort, supplemented by well-coordinated product development. The war and the shortage of rubber stopped its progress.

The synthetic rubber war-developments naturally led our research staff to investigate a series of butadiene-styrene resins. Then the painstaking groundwork paid off. The close integration of the sales and technical staff had resulted in a familiarity with the problem, which enabled the prompt selection of a suitable resin. It turned out to be a superior material and the sales staff was able to place it in the right places for acceptance.

Another case from the paint resin field is not quite so flattering. We were supplying our pigment bases with the pigment incorporated by dry milling on a rubber mill. This was the system adopted with the old Pliolite and our technical staff felt that it was the only satisfactory method for good pigment dispersions by ball-milling in the regular way, on their standard equipment. While we were arguing with them that satisfactory dispersions could not be obtained this way, several of them proceeded to do it anyway. As far as I know, the results are all right, if the pigment loading is not too high. Of course, our prestige as technical advisors was not greatly enhanced and we took no prizes for customer cooperation.

While in the paint field, we might mention a case where we were working diligently to overcome a customer's difficulty with so-called sag resulting from wall-application of a certain paint formulation. We had not been able to improve the situation without degrading the paint. However, there was close customer contact and cordial and friendly relations. The customer finally made a suggestion for modifying the resin, which worked and enabled us not only to meet his requirements, but to solve other allied problems.

At one stage in the market approach with our oil-resistant synthetic, Chemigum, we met with rather general resistance arising from the fact that our rubber required more milling time in its preparation than

did competitive materials. Our rubbers were being used extensively but not exclusively in our own plants. There was reluctance to modify the processing properties because of fear that the finished product would suffer.

In effect, we had two classes of customers, those on the outside who wanted the rubber changed for better processing, and those on the inside who wanted the rubber left alone, because of quality. The simple solution would seem to have been to make two varieties, thus pleasing both groups. However, this would have made a serious problem for the production department. We therefore, decided to try to meet both requirements. Development was undertaken which ultimately resulted in a rubber which processed satisfactorily and which, moreover, gave a superior finished product. This particular case required careful analysis of the facts, mutual confidence in the soundness of the views of the users involved, and close cooperation to work out a suitable compromise.

We find that a customer's confidence is favorably affected and his cooperation frequently secured because he finds our own organization —Sales, Development, and Production—working closely and harmoniously together. It not only conserves the customer's time and energy, but he is at once impressed with the fact that the ground is being covered thoroughly and systematically.

It is quite possible, however, with the best intentions in the world, to throw cooperative effort out of balance, because of physical discrepancies. One of these, within our experience, is inadequate pilot plant equipment for carrying through needed tests on modified products for customer development. This difficulty usually occurs when there is a pile-up in demand, from many sources, for use of the same type of equipment. Even the best foresight will not always forestall this.

Probably every company has had the experience, some time in some branch of its business, of poor integration between Sales, Development, and Production which has led to wasted effort. Since none of these fully understand the entire situation, there is a tendency to chase will-o-the-wisps and the result is confusion. One of the serious results of such a situation is the progressive loss of mutual confidence. However, even with a fully cooperative internal organization, there is danger of losing close touch with the customer. The product seems to be all right and sales are going well. It is a human tendency to forget about that product and turn attention to more pressing problems. Under these circumstances a product can develop trouble almost as fast as a neglected child.

An example of this can be drawn from our experience with a reenforc-

ing resin, Pliolite S-6. We believed it was doing a satisfactory job; our customers seemed to think so. We happily turned to the task of expanding our applications and our circle of customers. We suddenly awoke to the fact that we were failing to secure some promising new applications and, far worse, were losing some of the customers we had considered to be safely in the fold!

A quick check was confusing. Some of our best customers were perfectly satisfied. Others were having processing trouble and were turning to competitive products. Fast cooperative investigation by our sales and technical people revealed that trouble was coming only under certain extreme conditions, where customers were using very high processing temperatures. Since they did not wish to or, in some cases, could not, alter these conditions, it was necessary to develop a modified resin. Fortunately, there was complete accord as to what was needed and adequate experience to provide it. The condition was corrected, but we learned a new lesson about continuing customer contact and what the customer needs from his suppliers in the way of cooperation.

A pertinent example of the value of a cooperative customer comes from our experience with a customer who complained about stability of one of our latices he was using for coating purposes. Our relationship with this customer was such that he came in and told our technical staff very frankly and completely just how he used our latex. Our chemists immediately suspected that the latex was extracting chemicals from the material to which it was applied, and that these chemicals affected the latex stability. This proved to be the case and as a result, we developed a latex which was not only satisfactory to this customer, but was more generally useful.

Similarly a customer who was having trouble with our vinyl resin sticking to his calender rolls gave us sufficient information so we were enabled to modify the resin to correct the trouble.

So important is the human element that we have found cases where, after a long period of satisfactory use, a customer suddenly complains that he cannot use our material. Investigation discloses that there has been a change in key personnel. Either methods have been altered or new standards adopted. In such cases, there is only one thing to do—restudy the situation and meet the requirements as though it were a new account. Insistence on recognition of satisfactory past performance will merely make the solution more difficult.

The foregoing examples are admittedly fragmentary. They are not the exhaustive demonstration of any thesis. It is believed however, that

they give practical significance to the general statements made. It is hoped that the emphasis placed on the human element in new product exploitation will cause no one to neglect the tried and tested tangible factors which are essential to any first-class commercial effort.

We are prone to ascribe to our technical results a completeness and finality to which they are not entitled. Such results are valueless until they enable the achievement of some useful human purpose. Utilization of the pertinent human factors is as important to the accomplishment of this objective as is the construction of a correct scientific foundation. This discussion will have served its purpose, if your own convictions of these truths have been reenforced.

Factors in Fermentation Research, Development and Production

Sylvan B. Lee

Director, Microbiological Research and Development, Commercial Solvents Corporation, Terre Haute, Indiana.

(Abstract of a paper presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium on "Responsibilities of the Chemist in a Changing World".)

THIS paper deals with the transforming of the results of research into production in the fermentation field, with particular reference to antibiotic fermentations.

The tremendous impetus given to the fermentation industry with the advent of antibiotics and discussed along with further comments on the economics of the major commercial antibiotics, namely Penicillin, Streptomycin, Bacitracin, Aureomycin, Chloromycetin and Terramycin. It was pointed out that over 50 per cent of the total ethical drug sales in the United States in 1950 were in the form of antibiotics, and that the rate of increase in production each year is extremely rapid.

Through the use of a series of colored slides, a pictorial discussion was presented of the obstacles or hurdles which must be crossed successively and successfully in the development of a new antibiotic from the isolation of the original culture from the soil to the completion and operation of the large-scale production unit. A brief discussion was presented of the technique and procedures used in the procurement of soil samples, the isolation of individual micro-organisms from the soil, and the methods used for the detection of

antibiotic production by freshly isolated microorganisms.

The second portion of the discussion described the equipment and techniques used for the submerged production of the antibiotic in the laboratory stage, using rotary shaking machines, and the testing of the quantity and quality of the antibiotic produced through the use of antibiotic spectrum studies and agar streak dilution assay techniques. The latter point was followed by the description of microbiological assay procedure using the cup-plate method.

The next step consists of determining the complete bacterial spectrum on the antibiotic. This is one of the methods used for determining whether the antibiotic is a new one, and is the first major hurdle in the process of developing antibiotics. The paper chromatogram technique was also described, and this method is also very useful in determining whether the antibiotic is different from those already described in the literature.

After a discussion of the various methods used in the laboratory to concentrate and purify a small quantity of a new antibiotic, the animal toxicity test was considered. It was pointed out that the toxicity tests are the second major hurdle in the development of a new antibiotic, and that a successful crossing of this hurdle is indeed very encouraging.

After crossing the toxicity hurdle, the next step in the procedure is to develop, in laboratory-scale fermentors, sufficient quantities of the new antibiotic for use in conducting animal protection studies, which consist of the testing of the ability of the new antibiotic to protect animals against experimental infections.

In the production of laboratory quantities of antibiotics special laboratory fermentors are used. Several pictures were shown of five-gallon fermentors and fermentor bath equipment used for this purpose.

When sufficient quantities of the antibiotics are available in the laboratory, the animal protection tests are conducted. These consist of inoculating experimental animals, frequently mice, with a pathogenic bacterium and treating a portion of the mice with the new antibiotic to determine its ability to protect the mice against the infection by the pathogenic organism. If this hurdle is crossed successfully, it is indeed very encouraging, and it is quite possible that a valuable new antibiotic is at hand.

The next steps in the procedure are to scale-up the laboratory fermentation, extraction and purification procedures to pilot plant-scale operations so that sufficient quantities of material can be produced for clinical study. The equipment and techniques used for scale-up of the fermentation to 100-gallon fermentors and to 2000-gallon fermentors were described.

Steps discussed in the pilot plant extraction and purification operations

consisted of the various equipment used for the filtration of the final fermentation broth; the use of ion exchange resin columns for concentration by adsorption; centrifugal liquid extractors for the concentration of the antibiotic by solvent extraction. These steps are followed by concentration of the antibiotic by evaporation in low-temperature evaporators, followed in turn by further concentration, precipitation and crystallization of the new antibiotic.

The antibiotic material from pilot plant-scale production is then placed aseptically into vials, and, after it is given several very rigid chemical and biological tests, the material is ready for clinical evaluation by the medical profession.

If the clinical evaluation shows positive results, i.e., if the medical profession demonstrates that the new antibiotic has a definite place in the therapy of infectious diseases, the final stage of the process is then approached, namely that of designing and building a large-scale production unit and placing it into operation.

The various steps in the latter procedure were illustrated with colored slides of many types of equipment and the operations used in a commercial aerobic fermentation production unit.

From Photography to Foods

James Edward Magoffin, F.A.I.C.

Manager, Chemical Sales Development, Tennessee Eastman Corporation, Kingsport, Tennessee.

(A summary of a paper presented at the A.I.C. Annual Meeting, May 10, 1951, as part of the Symposium, "Transforming Results of Research into Production.")

THE very founding of Eastman Kodak Company is an example of the transformation of research results into profitable production. Mr. George Eastman had spent considerable time and trouble in developing a method for making practical photographic plates, and had determined that there should be a market for such plates, and resolved to fill this market by entering production. This he did in 1880. Since the founding of the company, an active research program has been one of its prime policies, and the transformation of research results into commercial production has been the story of the company's growth.

Tennessee Eastman Company was established in 1920 as the chemical-producing subsidiary of Eastman Kodak Company. Its reason for es-

tablishment and existence was and has been to provide a source of high-quality chemicals used in the manufacture of photographic film, paper, and for development of film and paper. Although Tennessee Eastman Company has continued to be the chief source of chemical raw materials for its parent company, it has also branched out into other fields until today a major portion of our production moves into these other fields. Because photography is the business of the Eastman Kodak Company, its research program has been guided primarily in this direction. Research at Tennessee Eastman Company was devoted in the beginning mostly to the branches of chemistry, physics, and engineering which would lead to improvements in the processes for making the various chemicals needed in the field of photography. As these process improvements were put into commercial operation, the lower-cost chemicals which resulted gave stimulus to research in the fields of utilization of these chemicals in applications outside of the photographic industry. Successful commercialization of some of these applications led to further research in some of these specialized fields, until today we are doing fundamental research in a half-dozen different fields of chemistry and physics at Kingsport.

The present discussion is about some of the results of research at Tennessee Eastman Company — both process and product in nature. The great shift in the film industry today from cellulose nitrate to cellulose acetate film has been made possible in part by the utilization of results of research at Kingsport. When the concept of safety film was first discussed, it was considered an almost impracticable ideal, because the cellulose esters available at that time did not have the dimensional stability necessary for use in the motion picture industry. Of almost equal importance was the high cost then necessitated by the production method available. Several years' research on methods of manufacturing cellulose acetate and cellulose acetate-butyrate were successful in developing methods which provided products of the necessary dimensional stability as well as alleviating somewhat the high-cost situation.

As an outgrowth of the research on suitable esters for film base, came research problems on producing a suitable cellulose acetate for yarn and suitable cellulose esters for plastic molding powders. Translation of these results into commercial production made possible a larger volume of cellulose ester manufacture and permitted further cost reductions in the cellulose esters for safety film.

Because of our interest in cellulose as a raw material, our Research Laboratories have from time to time explored cellulose chemistry quite unrelated to our primary interest in cellulose esters. For instance, one

line of research led to the production of an oxidized cellulose or polyanhydroglucuronic acid, which is soluble in mildly alkaline aqueous media. While this has no use in photography or plastics or yarn, it has proved to be an invaluable aid in surgery. As an adsorbable hemostat, it has become standard practice in many of the more difficult surgical techniques. A second line of attack in cellulose chemistry has led to the development of a stable cellulose sulfate salt. Sodium cellulose sulfate, for example, is quite soluable in water and shows remarkable stability for this type of ester. This is a new development and is only now in the process of being transformed from the research stage to commercial production.

One of the first chemicals produced for photographic purposes at Kingsport was hydroquinone. Eastman research developed a streamlined process for hydroquinone manufacture which was put into commercial operation in 1930. As improvements in the process were put into operation, the cost of hydroquinone was reduced until a technical grade could be produced at a low enough price to make it competitive with many other organic intermediates. By 1937, it was possible to consider hydroquinone as a chemical intermediate and it became the raw material for the manufacture of several rubber antioxidants, gasoline stabilizers, dye intermediates, and perfume chemicals.

As a result of the gasoline stabilizers produced from hydroquinone, Tennessee Eastman Company became interested in gasoline refining as a customer industry and a research program on improved gasoline additives was undertaken. A new inhibitor was introduced to the gasoline refining industry in 1941 and became the major inhibitor for both aviation and motor fuels throughout the entire World War II. It is now the chief inhibitor for all civilian gasoline.

With hydroquinone available as a relatively low-cost chemical raw material, our Research Laboratories began a program looking toward new products that could be made from hydroquinone. One of these, butylated hydroxyanisole, was found to be an excellent antioxidant for animal fats and possessed the particularly valuable characteristic of retaining its antioxidant properties even when the fat was heated to high temperatures. Fortunately, butylated hydroxyanisole had the necessary lack of toxicity to make it suitable for a food additive, and it was introduced to the fat industry in 1948. In the intervening time it has rapidly become the chief antioxidant for use in animal fats and in vegetable fats for heavy-duty, deep-fat-frying purposes.

Research at Tennessee Eastman Company has had many ramifications because of the great number of production processes and incidental

chemicals that have become a necessary part of our industrial activity. One of these has an interesting story. This is triethyl phosphate, a chemical used in relatively small amounts in one of our manufacturing processes. Forced to produce this to assure our own source of supply, we found ourselves relied upon to furnish raw material for tetraethyl-pyrophosphate.

The history of the developments at Tennessee Eastman Company is illustrative of the tremendous influence that a research program has on the growth of a company. Although the original object of our research was to provide improved raw materials for the photographic industry, following the various logical invitations to new explorations has engaged us in a host of other activities, some far distant from the photographic field.

Electric Furnace Smelting and High Temperature Chemistry

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(Excerpts from a talk presented at the AIC Annual Meeting, May 10,1951, as part of the Symposium on "Transforming the Results of Research into Production.")

TO properly conduct chemical reactions at high temperature in molten media, a good electric furnace, and a good electro-chemist, are essential. This might be interpreted as a plea for more and better trained electro-chemists, and in reality that is what it is.

The metallurgist is usually the man in charge of electric furnace melting operations. He is trained in metallurgy, and is proud of his calling. Whether the metallurgist looks upon the chemical reactions he is called upon to carry out in the electric furnace with the same degree of exactness as does the analytical chemist or the organic chemist, is open to question. Whether this is due to the fact that the metallurgist works at extremely high temperatures, and uses heavy and cumbersome equipment, and under conditions where controls are physically difficult, I am not sure. I am sure of one thing, and that is, that the good metallurgist must be a good chemist, and in dealing with the electric furnace, a good electro-chemist. I am sorry that to a large extent our colleges and universities are no longer teaching courses in electro-chemistry as such. Industry

needs electro-chemists in the ever growing use of the electric furnace, and this need will be greater as we are called upon to treat lower and lower grade ores, to supply our needs for metals.

The electric furnace is a highly efficient furnace for melting at high temperatures. It is possible to attain 65% to 75% energy efficiency at temperatures up to 1300°C, and higher. The specific heat of most slags is low, and most slags are capable of adjustment to carry out the desired chemical reaction.

Processes designed to make available all valuable constituents of the ores, no matter how small, will ultimately be required and the electric furnace is one medium by which such can be accomplished. Electric furnace smelting, and the application of high temperature chemistry has, I believe, many opportunities for the electrochemist.

Size of the Electric Furnace Smelting Industry

It is not possible to tabulate all the industries which make the electric furnace their base of operations. The statistics are available for a few of the larger ones, and these are sufficient to show the vastness of the industry.

In the ferro alloy field alone, 2,000,000 tons of ferro alloys are reported produced in 1950. From the estimated installed electric furnace capacity for ferro alloys in the United States of 640,000 KW in 1950, it is estimated that, of the total 2,000,000 tons produced about 800,000 tons were produced in the electric furnace. The remainder was produced as ferro manganese, spiegel and silvery pig in the blast furnace . . .

Types of Electric Furnace

The two principal types of electric smelting furnaces in use today are both of the arc-resistance type. They may be operated full "open-arc" where the heat is principally generated in the arc, or they may be operated fully covered (submerged arc) where the heat is generated partly in the arc and partly in the slag. The covering of charge may be a few inches to eleven, or more, feet. In slagging operations the electric furnace may be operated with the electrode tips slightly submerged into the slag. The electrodes should not be operated so deeply submerged in the slag that the heat is entirely developed in the slag by slag resistance; otherwise, a different set of conditions is set up which requires new treatment and design. Full resistance heating is principally used in processes like the production of magnesium, aluminum and carborundum. For the present purpose we are considering arc-resistance and full arc heating.

The electric furnace may be either single-phase—two electrode, single-phase top and bottom electrode, or three-phase with three electrodes. The particular operation determines the type of furnace to use but today the

three phase furnace is used wherever possible. This is due to the ease of keeping a balanced power load, which is required by most all suppliers of power. It is also favored because greater capacities can be had with sizes of the electrodes now available. The tendency of late has been to go to multiple circuits and size electrodes in order to get increased unit capacity.

In melting and refining furnaces, as typified by the electric steel furnace, the heat may be developed entirely in the arc/or in the arc and the slag. This type of furnace lends itself to a high degree of control of the slag composition and chemistry. It is dependent primarily on high voltage for increased loads (KW input) because of the high arc resistance.

Factors of Design

The design of the electric furnace should be governed by the condition that is desired at the tip of the electrodes, such as the temperature of the molten products, slag composition, metal composition, and heat concentration, and distribution . . .

From the electro-chemist's point of view the most important features of design are:

Voltage
Electrode Spacing
Size of Material to be Smelted
Heat Distribution
Electrode Size
Peripheral Ohm Factor

The correct voltage for any particular smelting operation controls the temperature and the position of the electrode tip in the charge.

Electrode spacing is one of the most important factors in submerged arc furnace. It is closely associated with the size of the material to be melted. These two factors are sufficiently important that to treat them adequately would require a complete separate treatment. In general, however, the electrode spacing, in my opinion, should be about as close as is mechanically possible.

Around each electrode there is an active area, outside of which, little, if any, smelting is done. These active areas vary some with different power inputs, and types of charges, but for the most part they will be from 15″ to 20″ outside the periphery of the electrode. The spacing of the electrodes should be such that the active areas around the electrodes come together or overlap. The electrode spacing further depends on the size of the ore. If the size of the ore is large, larger spacing is required in order that the furnace may carry a larger quantity of heat energy. If the ore is smaller it melts faster and if fed to a furnace with too wide electrode spacing the furnace can become frozen, and in three phase furnaces three separate smelting pools formed. This makes for poor and difficult operation, and low efficiencies, with metal freezing on the bottom . . .

Electrode size is limited by the current carrying capacity but even so the

size has considerable effect on the heat distribution which must be just right to maintain the heat concentration and temperature sufficiently high to maintain the maximum melting rate of the material charged.

Electrode size, spacing, heat distribution, and size of material smelted must all be co-ordinated to give the most economical result . . .

Phosphorus Production

The chemistry involved in the production of phosphorus is represented by the following equation:

$$2Ca_3(PO_4)_2 + 6\ SiO_2 + 10\ C = P_4 + 6\ CaO\ SiO_2 + 10\ CO$$

It is remarkable how well the chemistry of the above reaction can be controlled even though it takes place under a charge of 11 ft., or more, and with the charge continually moving into the smelting zone at a temperature of 1350 to 1500°C. Over reduction can produce silicon, calcium carbide, calcium phosphide and other products. A close carbon balance is required, and maintained, at all times, even though some single furnaces smelt 200 tons per day, or more. In a poorly designed furnace 1.75% to 2.00% P. can be expected in the slag produced. In a well designed furnace operating at about .43 peripheral ohms the slag can be held at .10 to .30% P. The control of the carbon can be so close, and tapping schedules so controlled, that continual low phosphorus slags (.10 to .30%) can be maintained daily.

High Carbon Ferro Chrome

High Carbon Ferro Chrome production is more complicated, and there are more reactions to control. The carbon reduction of chrome ore is represented by the following equation:

$$FeO\ MgO\ Al_2O_3\ Cr_2O_3 + 4\ C = Fe\ Cr_2 + MgO\ Al_2O_3\ SiO_2 + 4\ CO$$

Here MgO, Al_2O_3, SiO_2 as well as FeO and Cr_2O_3 can all be reduced with carbon. In addition the chromium has a high affinity for carbon and will pick up as much as 10 to 11% carbon. The usual product desired is ferro chrome containing 68-70% Cr, 4 to 6% C, and minus 1% Si.

To meet these specifications the electrochemist, in addition to proper control of the correct electrode size, voltage and peripheral ohms, must control the slag composition to give a correct temperature for the particular result desired. Low temperature slags will give high carbon in the metal. Low temperature slag will also result in metal freezing on the bottom. High temperature slags will give 4 to 6% carbon in the metal, but may give high chromium oxide in the slag. Carbon balance is extremely important and must be held within close limits. Carbon in quantity and size affects the position of the electrodes in the furnace with relation to the bottom. It determines silicon and aluminum contents of the metal. Too much fluxing makes for high slag

volume and high losses of metal in the slag.

In spite of all these variables the electrochemist, year in and year out, and with electrode tips under 3 ft. to 4 ft. of charge, and always smelting and reducing metal into the already molten slag and metal, daily holds the composition of the metal within the limits of the specifications of 4% to 6% carbon, .50% to 1% silicon, and 68% to 70% chromium. Good as the results are there is still room for improvement.

Melting and Refining

The best classic example, and the most advanced process involving melting and refining in the electric furnace, is probably the production of stainless steel and alloy steels. Here the electrical engineer, the chemist, and metallurgist, have combined their skills with remarkable results in both basic chemistry and physical chemistry at high temperatures.

Unlike the submerged arc smelting furnaces the electric steel furnace is an open arc furnace in which batches of steel are produced. The operations consist of charging, melting and refining . . .

It is not an easy task to meet specifications for quality alloy steels. The electrochemist and metallurgist, however, are meeting very close specifications, both as to chemical analysis and physical properties. The slags are controlled as to composition, removed as needed to accomplish a definite result, and replaced with another slag to accomplish another result. The electrochemist must prevent reversion of unwanted elements like phosphorus and sulphur to the metal once they are in the slag. He must prevent oxidization to the slag, of wanted metals like manganese and chromium. He must add oxidizers, deoxidizers and recarburizers, and must be able to control oxidation, deoxidization, or recarburization in the matter of minutes. He must add silicon, titanium, columbium, boron, tungsten and vanadium—all oxidizable elements—in very small percentages and make a high recovery of each. He must add nickel and molybdenum to meet very close specifications and not lose other elements by oxidation while doing it. He must maintain at all times the correct temperature and slag composition for the correct conditions for the reactions to take place. In addition the metal must leave the furnace at sufficiently high temperature to allow teaming into ingot molds, without skulls in the ladle and to obtain sound, clean ingots.

The chemistry and metallurgy involved in electric furnace steel making, both basic and physical, has been highly developed by many excellent electrochemists, metallurgists and engineers. They are producing millions of tons of steels and foundry irons,

meeting seemingly impossible specifications . . .

Surely the electrochemistry applied in making steel in the electric furnace is a fine example of what the good electrochemist can do in controlling chemical reactions at high temperatures. The 800,000 tons of stainless steel ingots and some 6,000,000 tons of low alloy steels and foundry irons and steels produced in the electric furnace is evidence of the skill attained by electrochemists in the steel industry of the United States.

Selective Reduction

The selective reduction and separation of one metal from another at high temperatures involves a knowledge of slag compositions and skill in the use of the electric furnace. It is not improbable that many of our low grade ores will ultimately be treated in the electric furnace for the economic recovery of the valuable metals. It is not at all impossible to develop the skill of the electrochemist in other operations as he has developed it in the steel industry and other electrochemical industries.

A beginning has been made in the selective reduction of iron from ilmenite by the Quebec Iron and Titanium Company who are already operating large 18,000 KW furnaces for the purpose of removing iron from ilmenite and expect to soon be treating 1500 tons of ilmenite per day.

Processes are being developed for the selective reduction of iron and impurities like phosphorus, lead, copper and arsenic from our low grade manganese ores in order to make them amenable to the production of standard ferromanganese, at least in times of emergency.

Processes for the separation of the easily volatilized metals like magnesium, potassium, zinc, lead or antimony are contemplated and being developed. The phosphorus furnace is a good example of the volatilization of the valuable constituent while producing a high temperature slag, and what might be done with other volatile metals.

Conclusion

The electric furnace is, in reality, an instrument for carrying out chemical reactions at high temperature. Properly designed for the particular purpose for which it is to be used, and in the hands of a good electrochemist, it is capable of maintaining conditions that will produce the required results with a high degree of accuracy.

The electric furnace and high temperature chemistry presents, I am sure, many opportunities for the well trained and imaginative electrochemist.

(NOTE: The complete paper will appear in *Canadian Chemistry and Industrial Processes.*)

Chemicals from Petroleum

Dr. W. J. Sparks, F.A.I.C.

Director, Chemical Division, Esso Laboratories, Standard Oil Development Company, Elizabeth, New Jersey.

(A report of a talk presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium on "Transforming Results of Research into Production.")

DR. SPARKS pointed out the rapid changes that have taken place in the development of chemicals from petroleum in the past few years. In the field of aliphatic chemicals in 1925, only insignificant qualities of these chemicals were produced. In 1945, petroleum provided the major source of these materials. Since 1945, petroleum has also provided increasing quantities of products previously obtainable only from coal. As one example, during the last war, the Humble Oil and Refining Company produced in one plant more toluene than the entire coal tar industry. Statistically in 1940, the total production of chemicals from petroleum amounted to 200,000 tons. In 1945, 1,650,000 tons of chemicals were produced from petroleum. In 1950, the figure was 2,700,000 tons.

In illustrating the rapid changes which had taken place in petroleum chemicals, Dr. Sparks recalled a lecture which Dr. Gustav Egloff, former president of THE AMERICAN INSTITUTE OF CHEMISTS, gave in Boston in 1939, in which it was predicted that butadiene would be produced for the manufacture of 1,000,000 tons of synthetic rubber. This statement was not widely believed at that time, but is now a matter of recorded accomplishment.

Dr. Sparks pointed out that, in 1933, when he worked in Niagara Falls as a research chemist, very few chemical companies there were interested in petroleum raw materials, a striking contrast to the situation at present.

Accepted: As members of the Scientific Apparatus Makers Association Century Club, the following companies which are celebrating their one-hundredth anniversaries this year: Corning Glass Works, Corning, N.Y., Eimer & Amend Division of Fisher Scientific Company, New York, N.Y., and Taylor Instrument Companies, Rochester, N.Y. The Century Club was founded in 1943 to recognize and honor 100-years of service by instrument and apparatus makers and distributors.

The Education of the Chemist—Cradle to Grave

Dr. Harry N. Holmes, Hon. AIC

Professor Emeritus, Oberlin College, Oberlin, Ohio

(Abstract of a talk presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium on "Professional Education of the Chemist.")

ADMITTEDLY there is a certain exaggeration in my title for little beyond practical nutrition can be done for the boy before the age of twelve. However I stumbled upon a unique type of chemical instruction for my son of about that age.

It was my custom to discuss my own research with my sympathetic wife (not a chemist), going over my plans in detail. She wisely remarked, "How interesting. And why do you think that would work?" In trying to make it clear and logical for her I naturally made it clearer for myself, very good discipline. The boy was sprawled in front of the fire pretending to be absorbed in his book. One evening he suddenly asked a very sensible question—which I took pains to answer. This sort of thing went on for a few years with more and keener questions asked by my son.

I have an idea that he got the research attitude of mind unusually early and that it will bear good fruit in his chosen profession as chemist. Perhaps those of you with children of twelve or about that age will experiment with my method.

At the high school age, too much is expected of the class of chemistry. In college they must repeat all they learned, with amplification. A good college teacher will convince such students that he is putting new and deeper meaning into the "old stuff". The chief value of the high school course is getting the lingo and appreciating the necessity of close observation. Fortunately for the teacher, the pre-college air is charged with electrons, thanks to radio, and no swallowing of definitions is required in that field.

The boy electing a chemical career early sometimes grows impatient of advice that he take something beyond science and mathematics. This is shortsighted and he must be made to appreciate the value of breadth in education. Our best engineering schools are now wisely insisting on this. Great scientific executives are not narrow men.

My own experience in teaching many thousands of college students has convinced me that teaching facts and theories is necessary (as tools are to the carpenter), but that the great-

est contribution of the instructor is teaching the student how to think scientifically. We hire a carpenter for his knowing how to use tools.

Formal, and formidable, research is generally supposed to belong exclusively to the graduate schools and to industry. However, I think a strong case can be made for its place in undergraduate training. Here the word must be given a breadth of meaning to include resourcefulness and research appreciation.

My own experiments in teaching over a very long period convince me that an appreciation of research thinking can be taught successfully in the first year of college.

As an illustration of the technique, I may mention an early opportunity—Lavoisier's experiments in discovering the meaning of combustion. Instead of allowing the student to tell me the whole story, I stop him after the first step or two and ask, "What would you have done next if you had been Lavoisier and had progressed just so far? Of course you would be dead now but you would be famous."

Usually the student glibly and accurately recites the statements in my text. I thank him for the compliment but remind him that he is not playing the game—that poor Lavoisier did not have my text at hand for ready reference. At last the rules of the game, and an exciting game it becomes, are clear to the entire class. The freshman has courage, perhaps, and insists that the step he described is just what he would have done. Then I floor him by demanding "Why?" To relieve his embarrassment and put the whole class on its toes, I suddenly pass the question to some other student. He carries the ball, possibly fumbling it, but I encourage him, and others, until the entire experiment has been worked out logically and convincingly. The next suitable occasion, and there are many such, gets a better response by the class and it becomes a game. I have never ceased to be surprised at their progress during the year.

In the laboratory the best students are only too glad to help the instructor in developing new experiments for succeeding classes. One of my own students invented an individual hydrogen sulfide generator so simple and workable that we used it in class for years. Another devised a separation of two metals not described in any book available to him although it was in the literature.

For twenty years or more, a small group of the ablest freshmen have been invited to tea in the private laboratory of one of the staff, there to discuss subjects somewhat beyond the capacity of the average class. Corners of research problems are tossed on the table for discussion, unusual apparatus brought out for inspection and explanation, and an atmosphere of original and critical

thinking encouraged. The group is proud of their name, "The Alchemists".

I see no reason why this freshman method of teaching originality cannot be used with classes in quantitative analysis and organic chemistry. The faults of traditional analytical methods and of certain organic syntheses could be discussed frankly, inviting students to suggest improvements. Such time would be well spent. Cautious laboratory testing of the best ideas would interest everybody concerned. For many years I gave a graduate course in colloid chemistry, lecture and laboratory instruction. In fact, it was probably the first laboratory course given in that subject in this country. The lectures were actually round-table discussions with an emphasis on the invention of better experiments for the laboratory work and for my book. Everybody was excited over the testing of the ideas developed. Some of my published research papers got their start in this class. I profited and the students "lapped it up".

The research encouraged by the above devices is talked about by the undergraduates, who consequently feel more confidence in the freshness of their instruction and more respect for the authority of the teaching staff.

Graduate training for a research career is well understood yet it is not completely standardized. Too great rigidity in years of training regardless of preparation, experience and ability is found in more than one institution. Interest-killing drill on a host of card-catalog facts is sometimes required as a proper foundation for a research future. Yet the graduate student is there mainly to learn the methods of research. He can be taught how to find his facts with a saving of time. Theories can be sparkling if their application, their invaluable services to problems, is stressed.

From here on to the grave the real chemist continues to learn. Otherwise he will not truly enjoy his profession nor will he be very effective. Perhaps he will decide to select a corner not too small in which he may hope to become an authority, as did Franklin with the ammonia system of solvent and reactions. In addition it will be wise for the growing chemist to keep an eye on the industrial field, on labor problems, on the social implications of science. Nor it it too much to ask him that he improve his writing and his public speaking.

With wide interests and a hobby or two such as painting, our ripe and mellow chemist will not fear the grave.

Appointed: Harry L. Ericson as chief chemist and T. A. Ruble as technical supervisor of Continental Carbon Company's new laboratory at 1440 West 10th Avenue, Amarillo, Texas.

Professional Training in Chemistry at Carnegie

Dr. Webster N. Jones

Dean, College of Engineering and Science, Carnegie Institute of Technology

(Presented at the AIC Annual Meeting on May 10, 1951 as part of the Symposium on "Professional Education of the Chemist.")

FORTY-EIGHT years have elapsed since I was exposed to my first high school course in chemistry—the beginning of my professional training as a chemist. I have seen, and in a small measure contributed to, the golden half-century of progress of our chosen profession. I have made many friends during my professional experience as teacher, industrial worker, employment scout, consultant, and dean. One, whom I first met forty years ago as a fellow student, E. Raymond Riegel, F.A.I.C., is chairman of this session. We were together at Harvard at a time when there were too few graduate schools of chemistry in America. I am confident that the scholastic standards in graduate work have greatly increased since then . . .

The ultimate measure of a curriculum is the productivity of the student subjected to it. In our day, Harvard turned out such men as Conant, Adams, Whitmore, Bolton, and many others—men whose names are associated with the great progress that chemistry has made and is making. We were greatly influenced by the professors who represented a community of scholars. I especially revere two of my undergraduate teachers — Professor Herman Schlundt and Professor Sidney Calvert; and two of my graduate teachers—Professor C. Loring Jackson and Professor Elmer Peter Kohler.

For the past nineteen years I have been Dean of Engineering and Science at Carnegie Institute of Technology. .

The development of professional training in chemistry at Carnegie Institute of Technology parallels the professional development of J. C. Warner, our president. He came to Carnegie Tech as an instructor in chemistry in 1926. He had received his Ph.D. degree three years earlier from the University of Indiana, and spent the interim doing research work in industry. He moved up rapidly through the academic ranks to become professor and head of the Department of Chemistry (1937), assistant director of the College of Engineering and Science and dean of Graduate Studies (1945), vice president and then president of C.I.T. (1950).

Dr. Warner's post as head of chem-

istry was taken over last year by Dr. F. D. Rossini, Silliman professor of chemistry, who came to Carnegie from the Bureau of Standards where he was head of the Thermochemistry and Hydrocarbons Section. Incidentally, Dr. Rossini has just been elected a member of the National Academy of Sciences. Carnegie's chemistry staff is composed of two other full professors, three associate professors, four assistant professors, and one instructor. The Department has, in addition, 22 part-time teaching assistants and evening school instructors.

The current enrollment in the Department of Chemistry is 64 undergraduate and 50 graduate students. Most of the latter are candidates for the D. Sc. degree. The Chemistry Department also has a heavy service load: teaching General Chemistry to all freshmen (350) in the College of Engineering and Science; Qualitative and Quantitative Analysis, Organic and Physical Chemistry to the Chemical Engineers; and Physical Chemistry to the Metallurgists.

You may ask, "What do all these statistics about staff and students have to do with Carnegie's aims for professional education in chemistry?" My answer is that they can mean little or much in themselves, depending upon the quality of the individuals involved. Although a plan of education is important, of far more importance is the quality of the teacher, the quality of the student, and the way in which they work together.

As for our staff, they have been selected most carefully. All of them, with the rank of assistant professor and higher, have doctor's degrees—earned from the Universities of California, Wisconsin, Pennsylvania, Minnesota, Illinois, Michigan, and from Carnegie Tech. All of them believe in our three fold emphasis on undergraduate education, graduate education, and research. Above all, these teachers like young men, and like to work with them, even though, as a consequence, their compensation is considerably lower than it would be if they were working in industry. Our students, too, are carefully selected. Only those who have built up outstanding high school records and who have the necessary qualifications of character and leadership are admitted.

The Chemistry Department, working with the other departments in the College of Enginering and Science, has gradually evolved a plan of professional education — one we are proud of because it is working! The aim of professional education at Carnegie is to help the student learn to think; and to equip him to go on learning after graduation and to grow throughout his life in professional and personal stature and in usefulness as a citizen. Carnegie does not seek to *train* students to *be* professional practitioners at graduation, but rather

to *educate* them so that they will *become* professional men of full stature. Instruction is therefore planned to help each student acquire the following:

(1) Thorough and integrated understanding of fundamental knowledge and a familiarity with the basic techniques in chemistry and related fields, and ability to use this knowledge and these basic techniques.

(2) Genuine competence in the orderly way of analytical thinking which scientists and other professional men have always used in reaching sound creative conclusions, to the end that after graduation the student can, by such thinking, reach his own decisions in his professional work as a chemist and as a citizen.

(3) Ability to learn for himself with scholarly orderliness, so that after graduation he will be able to grow in wisdom and keep abreast of the changing knowledge and problems of his profession and the society in which he lives.

(4) The philosophical outlook and breadth of knowledge which will enable him to recognize and deal with the human, economic, and social problems of his professional work.

Now if we are to accomplish these aims in undergraduate education: *first*, there must be a judicious allocation of the student's time in the curriculum between general education and scientific-technological education; second, courses must be arranged in logical sequence and the subject matter for each course carefully selected; and *third*, the scientific-technological education and the general education of the student must be so integrated that they are complementary parts of the whole process of professional education.

Implementation of the plan requires not only its official adoption by the faculty and administration, but success in the task, difficult for the faculty, of finding out how to teach so that the student will do the thinking and will gradually develop his powers to attack and solve problems under his own steam in true professional style.

After years of study and much experimentation, we have concluded that the 128 semester hours required for graduation should be divided approximately as follows:

Scientific-Technological		
Chemistry	50-55	
Mathematics Physics, etc.	38-33	
		88
General Education		
Humanities and Social Science	28-30	
Foreign Language	12-10	
		40
Total for Graduation		128

In our judgment a somewhat larger proportion of the student's time is needed to train him for technical competence than is set as a minimum requirement by the ACS Committee on Professional Training. We obviously give less curriculum time to General Education in the above schedule than is afforded in the typical liberal arts college, but it is greater than is provided in most professional curricula. We believe that

with a well-ordered, integrated series of courses in the humanities and social sciences and with education in these courses directed toward training the student to handle problems in these fields, we can make the general education portion of the student's professional education more effective than it was in the past.

You will be interested in the historical development of the plan of education that I have been discussing. The seeds of this plan were sown in a Report of the Committee on Curriculum and Scholarship on May 28, 1917. To quote a paragraph from that Report:

> "A complete education for an engineer should accomplish three things: It should give him such training as he may need for the successful practice of his profession; it should prepare him for the intelligent performance of his duties of citizenship; it should open his mind to the broadest possible interest in and appreciation of the discoveries of science and the beauties of nature and art, in order that his own life may be fuller and more interesting. Therefore, the question whether some of the time now given to technical subjects should be given to general subjects resolves itself into the question, which use of the time would be of most value to the future engineers. Undoubtedly the entire four years could be spent on technical work, and none of it be wasted. But it would be at the complete sacrifice of every side of the student's nature except the strictly professional side. Your Committee does not believe such sacrifice to be necessary. While recognizing that every hour deducted from technical training may entail some sacrifice of technical knowledge or skill, your Committee feels that the loss involved in the changes recommended in this report would be more than offset by the gain in other directions. And, finally, that such general training as we are recommending is itself a valuable asset to the engineer in his professional capacity, often even more valuable than would be the small amount of additional technical training which is eliminated."

As an outcome of this Report, the Educational Senate (action deferred by World War I) on February 23, 1923, passed the following resolution: That from 65 to 80 per cent of the training (in engineering and science) should be in the development of professional knowledge and skill, while from 20 to 35 per cent of the training should be in imparting general education or cultural knowledge.

This ruling is a tribute to the great perception of the educators involved in framing it, and made all of the development work that has followed it easy by comparison. It has had a profound effect not only on the chemistry curriculum at C.I.T. but upon the whole of our science and engineering education.

I hope you will recognize that much of what I have said is equally applicable to graduate education. The primary difference is one of degree. A sound undergraduate background is essential to a man who is to take graduate work, and graduate work is essential to a man who is pointing for research as his life's work. The complexity of the problems involved in modern chemical development de-

mands scientists with the following abilities and attributes:

1. Competence to do significant independent research, and imagination and enterprise in investigations.
2. Mastery of the basic sciences of his chosen field.
3. Ability to exercise critical judgment in evaluating his own work and that of other investigators.
4. The power, to a high degree, to analyze complex problems and produce useful solutions.
5. A reading knowledge of at least one foreign language in which there exists significant literature in his chosen field.
6. And, throughout all of his work, a scholarly style.

Research Activities

In addition to directing the undergraduate and graduate programs, our chemistry staff is busy in research. The reason is threefold: *first,* to guide the student in research; *second,* to keep the scientists on the college faculty—and to keep them alive; and *third,* to add, as the colleges have in the years gone by, to the world's store of knowledge. Some of our research is contract research sponsored by government agencies, such as the Atomic Energy Commission and the Office of Naval Research. Dr. Rossini directs the Petroleum Research Laboratory, which is supported by the American Petroleum Institute, and in which are employed some 15 full-time professional employees. A great deal of research done in the Department is supported by C.I.T. funds. Needless to say, all of the research is *fundamental* research. To give you some idea of the scope of the research done by the Chemistry Department staff, there are today some 64 different research projects active. From July, 1945, to December, 1950, the staff had 61 papers published giving results of their research work. But lest you gain the impression that research is being over-emphasized at Carnegie Tech, I wish to assure you that there is a balance between undergraduate work, graduate work, and research. A college should be primarily an educational institution, not a research institute.

Industry-College Cooperation

Our interest in our students does not stop at graduation. Since the bulk of our graduates enter industry, I would like to mention those early critical years of internship following graduation—the period in which the individual is supplementing his formal training by learning the approach and methods of industrial research in order to eventually attain professional competence. This period is largely industry's responsibility. The development of professional competence in its scientists is not a charitable nor a philanthropic undertaking for industry; it is a sound investment, sometimes in immediate return and always in the long pull, for the greatest asset of any company, large or small, is its personnel. The most significant aspect of training is arranging manpower so

that the beginners are intimately associated with those who are skilled and possess the rare ability to teach others. Such relationships do occur in industry—perhaps more frequently by chance than by design—but everything should be done to foster them. Along with the supervision there must be rewards in more complex assignments as well as increases in compensation for work well done.

The colleges and industry each have separate responsibilities in the training of a chemist, but theirs is a joint responsibility as well. There is need for much greater industry-college cooperation than we have today. This subject is receiving impetus by the activities of the Relations with Industry Division of the American Society for Engineering Education, by Committees of the Engineers' Council for Professional Development, by your own Institute, and by some of the national engineering societies.

The colleges need support and the best support is through fellowships, endowed professorships, cooperative research, sponsored research, and outright gifts from industry. The important point is that the colleges—particularly the private endowed institutions—need more money, big money, to do a better job for industry and for society, and the only real sources available for it are industry and government. The more industry gives, the less will be required from government.

Professional Stature

Chemists have a natural interest in steadily improving their professional stature, and they are looking forward to being held in such public esteem as has been accorded to the older learned professions. In the urge to attain improved professional status, there has been much controversy among chemists over licensing, registration, and graded memberships in the societies representing the profession. The professional societies properly pay considerable attention to fostering the professional growth of their members. In the main, they realize that professional stature depends not upon legal enactments, but upon the extent to which chemists live and work like true professional people.

If an affirmative answer can be given to the following questions about a chemist, he is a man of real professional stature.

(1) Does he recognize the real nature of the problem with which he is confronted, and can he state the problem concisely and clearly?

(2) Does he recognize the whole problem including its human, social, and economic elements?

(3) Can he formulate a plan for the solution of the problem and execute the plan?

(4) Can he exercise judgment concerning the general reasonableness or validity of his solution?

(5) Has he the will and the capacity to learn from each experience?

(6) Does he accept his responsibilities as a citizen of his community and the nation?

This is the kind of man we are trying to develop at Carnegie.

The Meaning of Professional

Dr. M. H. Trytten,

Office of Scientific Personnel, National Research Council, Washington, D.C.

(Presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium on "Professional Education of the Chemist.")

I WOULD like to venture a few remarks on the peculiar significance of the word "professional", because it seems to me to have a certain unusual significance today. The word professional derives from the word profession and and the word profession is full of meaning.

There are many types of jobs which human beings use as the bases of livelihood. Some are routine operations requiring little skill or knowledge. Some are jobs depending much more on nimbleness of wit or manual dexterity than on long training. Some require mostly an ability to deal with people or events or mere alertness and personal drive. Some depend most largely on sheer acquisitive instinct.

In all the gamut of jobs, however, there are two main categories which are usually thought of in terms of long training. These are the *skilled crafts* and the *professions*. The skilled crafts or the trades are those activities where the intricacies of the operations or the delicacy of control required can be acquired only after long apprenticeship. By and large, these skills are not acquired in schools, although they may be in whole or in part. More frequently they are acquired by learning on the job. And the component of training which depends on the reading and mastery of recorded experience is a minimum. The skills are seldom acquired from text books. Finally and perhaps most significantly, the factor of public responsibility for the social role of the skill is usually either absent entirely or is a minor consideration.

In the professions, however, the reverse is true in many of these aspects. One does not acquire professional status except after a long and rigorous training. Much of it in-

volves long and arduous devotion to the personal mastery of recorded knowledge. The text book and the reference work are the indispensable sources of most of the knowledge and skill of the professional. And quite frequently he does not acquire status in his profession until he has so mastered its substance that it becomes a part of him, conditioning his thoughts, and stimulating his creative imagination until he becomes the source of new ideas, new extensions of the domain of the profession, and new and better methods and techniques for the extension of its scope and its usefulness.

But more significantly, *the most characteristic difference between the professions and other vocations is the public and social responsibility which it entails. The member of a profession deals with knowledges and skills which are of great significance to the public welfare.* These skills and the body of knowledge behind them are usually beyond the understanding of the vast majority of the population. They can be used for good or ill. Consequently, frequently only the integrity of the individual and his professional colleagues stands in the way of the misuse of the training and experience enjoyed by the professional himself.

The professional person must take responsibility for the continuity of his profession and the transmission to generations to come of the knowledge which has been passed on to him. Usually the training required is so arduous and exacting that without formal training, institutions, and the devotion of persons of the profession motivated by high ideals of service and the love of their profession and the students entrusted to them, the deterioration of the profession would inevitably follow. The professional competence of today is the result of the painstaking work of generations upon generations of students and creative thinkers for hundreds of years, each age carefully and devotedly passing on to the next the living fire of its vitality. It is this responsibility which is the greatest for the profession.

But there remains the great responsibility of insuring that the profession is of maximum benefit to the public welfare. It would be possible for a profession so to forget its responsibility as to think of its knowledge and its skill as its own sole possession by divine right, and usable for the personal gain of its members without regard to the welfare of others. This is not the attitude of the professions. They know that this knowledge and the power they possess are not of their own creation nor are they their personal heritage. It is the result of the work of countless thousands of patient, tireless and inspired workers down through the ages, each adding to the store of knowledge and passing on the whole to the hands of

the next succeeding generation. The member of the profession today knows that he is merely today the trustee of a priceless heritage, its guardian and its servant. It is his responsibility to assure that its benefits are made available to society and that it is passed on to those who follow him, enriched and even better able to serve the generations to come.

This professional consciousness has never been more clearly needed than today. For the science you represent and the science I call my own are professions of the very greatest importance to the society in which we live. The science to which you are devoted is fundamental to the functioning of the healing arts and to the spread of their competence, to the growth of food and the perfection of nutrition, to the creation and proliferation of materials of manufacture of all kinds and for the creation of manifold instrumentalities for national defense and security. You have intimate responsibility for the full utilization of chemistry for the welfare and safety of our people and for the training of personnel so that your science can continue to make its maximum contribution to these ends.

The responsibility of scientists for the training of the next generation takes a peculiar form today. For now the picture changes as a result of present day conditions. Heretofore, this responsibility has been met by constantly building up our training facilities, our great university departments of chemistry, their great research laboratories where advanced graduate and postdoctoral training could be carried out, and the great institutes and industrial laboratories where training was just as important a function as research and, in fact, was an inevitable and conscious by-product of the research program.

Today the problem is one of defense and not of attack, of preventing the retrogression of teaching instead of increasing the flow of students. Several factors are here important. Let me sketch the situation that faces us:

America, in the last war, performed one of the greatest military miracles of all time. In little more than a half dozen years, this nation started from a state of relatively low preparedness in the military sense and rapidly built up to a level of military might beyond that of any other nation. It did so not by numbers of men but by the creation and production of great floods of military instrumentalities which made use of the most modern technological developments, many of them created under the stress of war conditions. *It was the power of applied science which tipped the balance so clearly and so convincingly.*

This lesson is clearly understood by the rest of the world. It can be taken for granted that if war shall come, it will be when the applications of science and technology by the

enemy can challenge our own. *Every indication is that the war of technologies is every bit as real and as determined as the war of the battlefields, and of the oceans and of the air. There is evidence that this has lead to unprecedented emphasis on training behind the iron curtain. It is a national effort and a national policy on the part of the Soviets to stress the development of technology and its military applications. In America we have never so considered education heretofore. The training of scientists has been a fortunate and beneficent by-product of other interests, more than a conscious effort to fill an important national need.* For example, up until 1941, the vast majority of physicists trained to the doctorate in America were supported by teaching assistantships. These assistantships were available because engineers and other preprofessional students were required to take courses in physics. Physicists were, therefore, to a large extent by-products of the teaching of engineering and medicine. Chemistry graduate students were somewhat similarly supported, although not quite so directly related to those two fields.

It is imperative that this situation change. The role of science now in the national life and in the national security is too fundamental to be left to chance or to the beneficent operation of fortunate social movements. For there are too many reasons to believe that these movements can be readily interfered with by other movements suddenly arising out of the rapidly changing circumstances of a nation in the stress of meeting a world crisis. *It has been only too clearly evident lately that mobilization policies alone can alter the whole pattern of American education.*

The professions cannot ignore this problem. If the responsibility for passing on the torch of learning to the next generation is a basic one for the professions, then this responsibility is just as real in relation to assuring an adequate provision by public policy for training, as it is in the more usual traditional activities of the past. No one can understand the powerful but subtle factors so important to the development of a chemist as the chemists. No one can speak so authoritatively as they in pointing out the conditions which have to be met if the science is to have the needed flow of students in training, to assure that chemistry can perform its part in the future security of the nation and in its future welfare.

There is no room for complaisancy in the present situation. We know the demands for chemists are high, apparently much higher than the supply. In a recent meeting of representatives of 120 leading scientific laboratories in the United States, these men were asked how many of them were experiencing real difficulty

in securing the services of needed additional scientists. Every company represented reported they were. It is known that the budgets of the military services will place an additional and severe demand on scientific personnel. Dr. Eric Walker, the executive secretary of the Research and Development Board recently said in San Francisco that the expanding programs of the services would eventually require three-fourths of all the technically trained personnel in the nation.

The research and development budgets are more than doubled and the procurement contracts are flowing out at a rate which now must be about a billion dollars per month.

Against this unprecedented demand for scientists, there are a number of disturbing factors with regard to the supply which is now available and which will become available. These factors have been difficult to discern because of the extraordinary situation produced by the GI bill. The large enrollments of the past few years and the peak enrollments now in graduate schools have resulted in the general belief that we were moving into a period of rapidly expanding training at the higher education level. .. ...

This is not in general correct. There has been a steady increase in the percentage of young men attending college for several decades in America. The present indications are that when the GI episode is over, there will remain a small residual increase over the percentage attendance of pre-World War II. But this will not by any means keep pace with the apparent increase in the peacetime demand for scientists. It is possible to estimate what should happen over the next four years. We know that the percentage of the baccalaureate graduates in the sciences does not vary sharply over the years for which information is available. We know present enrollments and probable rates of attrition aside from any impact of the draft. Consequently, leaving the effects of withdrawals for military service aside, the graduating classes in the sciences at the bachelor's level for the next few years should be as follows, with the class of 1950 listed for comparison:

1950	68,000
1951	53,000
1952	39,000
1953	39,000
1954	36,000

This includes all sciences except engineering. Obviously, the flow into industry and the graduate schools will be reduced greatly.

But perhaps the most significant feature of the present situation is that the effect of mobilization can not be ignored. *It seems likely that at least thirty per cent of the graduates of 1951 will immediately enter the armed forces because of ROTC status or status in the National Guard or organized Reserves. This will reduce*

the number available for industry or other employment to 37,000 in all the sciences, and from this losses to Selective Service must be reckoned with.

If I may leave with you any single thought, it is that this is your business. You must be aware of these problems. You can help in the guidance of public policy. (*This nation dare not forget that mobilization is not alone the training of men in uniform.*) *You can assist in making this clear and in guiding the thought of the planning agencies so that adequate consideration to the questions of training may be given by those in authority. You can help say how many are needed, how they should be trained and how their proper utilization can be assured.*

Professional Education—for Depth or for Breadth?

Dr. Emil R. Riegel, F.A.I.C.

Professor of Chemistry, University of Buffalo, Buffalo, N.Y.

(Presented at the AIC Annual Meeting, May 10, 1951, as part of the Symposium, on "Professional Education of the Chemist".)

PROFESSIONAL education for depth means an education based on a specific curriculum which is intensely specialized, which addresses itself to a single aim—the mastery of the science—or better, the preparation while in the University of the student for subsequent mastery of his field, with no concern with any other study. It is a specialization which will supply original contributions to the fund of knowledge in the science, contributions which will generally be related to each other, and often will rest one upon another until the scientist is not only well acquainted with his field, an expert in it, but an authority in it (with the scientists' understanding of the term). He becomes known as a worker in the special field; a distinguished worker.

Professional education for breadth would be the preparation for activity in the field of chemistry without the stifling of every other mental yearning of the student; without neglecting every other activity. It is conceivable that the student should prepare himself for future work in two fields, perhaps related, but best unrelated. If related they might be at least distinct. Besides that, it would mean for the teacher the giving of encouragement to seize every opportunity to learn about adjacent fields of knowledge; close by, in the form of the other

physical sciences or, further away, in non-scientific fields, artistic fields, philosophical subjects, literature, the drama.

Carried to an extreme, the chemist educated professionally for depth would know, if the educational process had been successful, a narrow portion of the field and nothing outside of it. Seated at dinner with a fellow-worker, he would be voluble, and have hardly enough time and opportunity to express himself. Place him next to a wholesaler of men's coats and suits, or a dentist, a retired sheriff, or a musician, innocent of any trace of science and with no interest in it, and he will find nothing to say. The future chemist, educated for breadth, on the other hand, again assuming that the process has been successful, could readily enlist the interest of any non-professional in one or more topics away from his science, tucked ready-to-hand in his mind for just such an emergency.

Let us examine for a few moments the force that makes for depth, and then the forces that make for breadth, factually and objectively.

The Forces that Make for Depth

The professional education of the student chemist reflects the fields, topics, features and methods which, in the opinion of his teachers, make for success, as that term is generally understood. The nature of our occupation leads us to make observations, to establish facts and devise explanations, to probe the foundations on which arguments rest, to ask endless questions, generally of ourselves. All that makes for depth. From the standpoint of chemical science, the matter in hand may have broad application, such as the electron theory of the elements, and of reactions, but generally the field of application covers a small area, and even in the evolution of broad theories and fundamental laws, many men took a hand, not just one, contributing a step, or reshaping an earlier argument to make it more nearly perfect. This then is force number one, the nature of our calling.

A telling force pushing the scientist in the direction of depth and, therefore, shaping his training while a student (by his observant teachers) in that same direction, is the reward awaiting the scientist. Let us consider the academic institutions. Who gets a promotion in rank, and increase in salary? Why, the distinguished discoverer of a new reaction, for example, and it is the discovery itself which confers the distinction. Who is invited to a neighboring, or for that matter, faraway University to give a lecture, or a series of lectures? Again the scientist who has concentrated on a small area, or a specialty. That is as it should be, and I would not change it. We are here merely examining the facts and their relation to the professional training of the

student. To continue, who gets the Nobel prize? The Schoellkopf medal, which is otherwise limited to the Buffalo-Niagara area, the Perkin medal? Definitely, the worker who made an outstanding contribution to the pure science or the applied science.

The American Chemical Society requirements which must be met, if the school is to remain in good standing, are another force which makes for depth, at least in the opinion of some educators. Most of the educators in the departments of chemistry are likely to consider them minimum requirements.

The very magnitude of our science, its constant growth, its ever-expanding boundaries, makes for depth. We are pushed into it by the need of selecting a smaller portion in which one might reasonably hope to keep informed of the newer development. The extent and manifoldness of the science of chemistry is well-shown by the number of Divisions. At the International Chemical Conclave scheduled in New York for September 3rd to 9th, 1951, there are listed twenty divisions, each of which is to hold a Symposium on its specialty, while the International Congress, September 9th to 13th, will have sixteen sections functioning.

Still another force making for depth in the student years is the reluctance of students to register for courses other than their specialty or subjects closely related to them. Many of these are set by the department, but even upon the suggestion of the adviser, the student fails to see the advisability of taking philosophy, psychology, or an advanced literature course.

A still more unfortunate force is a high school preparation which itself is specialized too early, and predisposes the student to do just exactly what he should not, that is, accentuate his specialization still further at the cost of no breadth at all.

The Forces Which Make for Breadth

Having paid our respects to depth, acknowledged that I am in favor of it, in favor of continuing the high reward for successful activity in depth, the audience will wonder what there is left to say regarding breadth.

Well, there is a great deal left to say provided we agree on the final purpose of all human activity. The final purpose is a happy life, a satisfactory life especially from the professional standpoint, a richer life. For life to be richer, there must be more faculties for enjoyment, more contact with a greater number of people, and concerning matters additional to the one of prime importance to us, chemistry. The man who has only his specialty withdraws of necessity within a narrow world, the world of the few who share his interest.

THE AMERICAN INSTITUTE OF CHEMISTS is devoted to the study of the man who is a chemist. It follows

that it concerns itself with his well-being and certainly his happiness.

Breadth in a narrow sense is exemplified by the career of Dr. Paul Walden, of Rostock on the Baltic, whose work in organic chemistry gave us the Walden inversion, and in inorganic chemistry, the conductivity and other properties of electrolytes in solution.

Breadth in a broader sense is exemplified by the little-known activities of Dr. Charles L. Reese, for many years director of research of the du Pont Company. Dr. Reese was a top-flight chemist, and to all the chemists he knew and who knew him, he was just that. But to a large group of artists, Dr. Reese was known as a connoisseur and collector of etchings, including several Duerers.

Real breadth is achieved when the chemist has developed or acquired a welcoming attitude toward other subjects, a willingness to grant that other studies, other pursuits, may have values of their own.

The old breadth in science is gone for good. To-day it is more likely that division into two or more parts of the field covered by chemistry will be made.

Breadth can only contribute to the art of "knowing how to get along with other people", with people who work with you in the same factory, over whom you have no directive control, also with those who are under your control. It is a quality hard to define; a matter of deportment; a cumulative impression in the collection of which nothing is left out (and some may be bad). The more difficult it is to write the specifications for a position, hence for a man to fill that certain position, the higher the award to the person chosen. It is true of the highest position in a large corporation, it is also true of the intermediate positions. The person selected possesses a certain combination of qualities, which are not listed, nor analyzed, and the combination is, in my estimation, never twice the same. It is the result of an evaluation, a judgment of behavior of reactions, all done unconsciously.

One aspect of the study of a science is broadening, and that is the international character of science. We don't inquire, and hardly notice, what the nationality of a scientist is.

Conclusion

The forces that make for depth are irresistible, and education for depth is to be recommended, but it should be supplemented by the systematic, or at least occasional study of selected outside subjects.

Every student should undertake outside reading on an individual basis but systematically arranged, especially during the summer recess, while at college.

The student should be encouraged to select a second field of study, not a "minor", but an independent study which he will explore far enough to

know its quality and attractiveness, to learn to "speak the language" of the devotees in that field. In that way he will become one of a second group, made up of different persons, who place different values on various activities, endeavors and achievements. Such mingling intelligently with a second group of individuals will contribute considerably to the quality of "knowing how to get along with people."

For us of the academic world, let it be resolved that we abandon, or never adopt, a flippant attitude toward other fields of learning, but strengthen the student's fairness of judgment and appraisal of unrelated fields.

New Partnership: Joseph F. Padlon, F.A.I.C., Albert M. Austin, and Harold F. Wilhelm, for the practice of law under the name of Austin, Wilhelm & Padlon, 120 Broadway, New York 5, N.Y. Allen A. Dicke will be associated with the firm as counsel. The firms of Austin & Wilhelm and Dicke & Padlon are being dissolved.

Elected: Dr. Oliver E. Buckley, formerly president of Bell Telephone Laboratories, as chairman of the Board, and Dr. Mervin J. Kelly, formerly executive vice president, as president.

Guests of Honor: C. C. Concannon, F.A.I.C., Alden Emery, F.A.I.C., Percy C. Magnus, A.A.I.C., and Robert Taylor, F.A.I.C., at the Silver Anniversary Dinner of the Drug, Chemical & Allied Trades Section of the New York Board of Trade, in New York, N Y., on March 8th.

Fifty-fourth Annual Meeting: The American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 18th to 22nd. At the luncheon on June 19th, honorary memberships will be awarded; forty-year memberships will be recognized, awards of merit will be presented, and the retiring president will give his annual address. On June 20th, the 1951 Edgar Marburg Lecture on "Corrosion Testing" will be given, and the Charles B. Dudley medal and other awards for outstanding technical papers will be conferred.

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Foster D. Snell, *Past President*
Raymond Stevens, *New England Chapter*
Manuel Tubis, *Los Angeles Chapter*
Florence E. Wall, *At-Large*

Annual Report of the Secretary, 1950 - 1951

THE National Council held nine meetings during the year, with an average attendance of eleven officers and councilors. The following actions upon membership were taken:

Elections

Life	2
Fellows	114
Members	38
Associates	57
	211

Reinstatements

Fellows	4
Members	1
	5

Loss of Membership

Resignations

Fellows	35
Members	8
Associates	12
	55

Dropped

Fellows	48
Members	17
Associates	48
	113

Deceased

Honorary	1
Life	1
Fellows	22
Members	1
	25

Total Increase of Membership	216
Total Loss	193
Net Increase in Membership	23

Actions

Fellows to Honorary	4
Fellows to Life	2
Members to Fellows	9
Associates to Fellows	1
Associates to Members	1

Total Membership as of May 1951

Fellows	1875
Members	306
Associates	249
Life Members	31
Honorary	28
Total	2489

It is with deep regret that we record the following deaths, about which we were notified during the year:

William C. Bainbridge, F.A.I.C.
Thomas D. Dudderar, M.A.I.C.
William H. Gabeler, F.A.I.C.
Robert Glenk, F.A.I.C.
E. M. Hanzely, F.A.I.C.
William D. Harkins, F.A.I.C.
Josiah P. Harmer, F.A.I.C.
Seymour M. Hermann, F.A.I.C.
Charles J. Holland, F.A.I.C.
John H. Kelly, Jr., F.A.I.C.
V. N. Kokatnur, F.A.I.C.
Charles A. Mann, F.A.I.C.
Thomas W. Mason, F.A.I.C.
Emory F. Marsiglio, F.A.I.C.
Margaret Masten, F.A.I.C.
James E. Mills, F.A.I.C.
Vittorio Molinari, F.A.I.C.
A. Cressy Morrison, Hon. AIC.
Harley A. Nelson, F.A.I.C.
Harry T. Newman, F.A.I.C.
Karl D. Schaaf, F.A.I.C.
Harvey Seil, F.A.I.C.
James N. Taylor, F.A.I.C.
Samuel G. Trepp, F.A.I.C.
Emil K. Ventre, F.A.I.C.
Philip A. Wright, F.A.I.C.

This year we have welcomed 211 new members into the INSTITUTE, an increase of 35 over those elected last year.

The following Fellows of the INSTITUTE were elected to Honorary Membership: Jerome Alexander and Alexander Silverman. Honorary Membership was also conferred on Dr. Robert E. Swain and on Drs. Walter J. Murphy and Harry N. Holmes, the Medalists for 1950 and 1951.

A new A.I.C. Chapter, the Alabama Chapter, was organized by Dr. Emmett B. Carmichael of the Medical College of Alabama. It was approved by the National Council on June 14th.

The Chicago Chapter requested and received the Council's cooperation in its endeavors to bring before the Federal Wage and Hours Division Administrator the need of an upward revision of the minimum salary set for professionals in the revised Fair Labor Standards Act.

The Council in June approved in principle the proposed Employment Project conceived by the New York Chapter, and cooperated with the Chapter to work out the legal aspects of the proposal. In more complete form, the Project was brought to the attention of the membership through publication in THE CHEMIST, where the support of the members was requested, either through gift or loan. Promises of about one-quarter of the amount requested have been secured. The New York Chapter is continuing its careful guidance of the project toward its final completion. In the meantime, until the final completion of the Employment Project, the Secretary's Office has amplified its service to those seeking employment. This includes encouragement and assistance in the writing of resumes, writing advertisements to be placed in THE CHEMIST (for members free of charge) or elsewhere; advice on the type of position for which the applicant is qualified; where to seek such employment; the procedure in presenting qualifications to employers; the sources to consult regarding direct contacts. Service rendered to those seeking employees has included a column in THE CHEMIST which lists positions open; the referral of suitable applicants, if and when available, and the suggestion of other sources to contact, including advertising in technical journals.

We have been informed that the following Chapters will award Student Medals this year; Chicago, Los Angeles, New

York, Niagara, Pennsylvania, and Washington.

The Council considered favorably the report of the Hoover Commission for Economy in Government.

The Council went on record to approve Bills introduced into the New York State Legislature sponsored by the N. Y. State Society for Medical Research, to make impounded animals available for medical study.

Communications from the President's Board on Water Conservation were presented to the Council, which offered its cooperation.

Several special committees were appointed, among which was one to Consider the Scientific Manpower available in this time of National emergency; another to cooperate in the formation of the American Board of Clinical Chemistry; a third to arrange an A.I.C. Dinner to be held during the week of the meeting of the International Congress of Chemistry in September, 1951; another to prepare a message of congratulations to the American Chemical Society's Diamond Jubilee Meeting, and one to send greetings to the meeting of the South American Congress of Chemistry at Lima, Peru, in May, 1951.

INSTITUTE get-togethers, such as breakfasts luncheons, or dinners, were held at several regional meetings of the ACS.

Many other interesting activities of the Chapters and committees of the A.I.C. will be found in the reports to the Annual Meeting, which will be published in early issues of THE CHEMIST.

Credit and appreciation are extended to the many members of the INSTITUTE who have given generously of their personal time and effort to advance the professional status of chemists.

—Lloyd Van Doren, Secretary

Editor's Annual Report, 1950 - 51

More questions than usual have been asked by readers of THE CHEMIST this year about general publication information. The following facts may answer these questions, and may also merit the interest of all readers.

Circulation: THE CHEMIST has a total monthly circulation of 3500 copies. This represents the membership of the INSTITUTE, plus about 1000 additional subscriptions, which include those from technical libraries, colleges and universities, other publications, advertisers, and individuals.

Distribution: THE CHEMIST in addition to copies mailed to the United States, is sent to subscribers in forty-three other countries of the world. The largest number of foreign subscriptions goes to England, Germany, Russia, India, Brazil, the Philippines, and South Africa.

Financial: One of the most frequently-asked questions is: "Does THE CHEMIST pay for itself?" THE CHEMIST does pay for itself, and sometimes shows a small surplus at the end of the year, though it is rare that publications which circulate to a specialized group in these days of inflation can be kept self-supporting. THE CHEMIST derives its income from advertising and subscriptions. These two sources cover its publication expenses which are kept to a minimum by a cooperative printer who appreciates our problems and by the exercise of special care to economize where difference in cost is not appreciably apparent. The number of pages per issue depends upon the income for the period. An increase in income is reflected by an increase in the number of pages per issue. Readers of THE CHEMIST can help to increase the pages available by not only purchasing whenever possible from the advertisers, but also by mentioning that they saw the advertisement in THE CHEMIST.

Survey: Recently a survey was made for our advertisers to find out the nature of the market for chemical products and equipment among the members of the INSTITUTE, and to learn if they read the advertisements appearing in THE CHEMIST. A total of 2200 questionnaires was mailed to INSTITUTE members, and though there was no reward for filling them out, 754 (33%) replies were received. Seventy-four per cent of those replying said that they have a voice in ordering equipment; fifty per cent said that they were consulted and must pass on their company's equipment orders; and twenty-five per cent were the final judges on all company orders for products and equipment. Thirty-six per cent of those replying said that

they read THE CHEMIST more thoroughly than other chemical publications. From these figures, it is apparent that advertising in THE CHEMIST reaches a profitable market.

THE CHEMIST's Content

At the end of this fiscal year, as we look over the material which INSTITUTE members have supplied for publication in THE CHEMIST, we are impressed by the breadth and depth of their views on many subjects and by the originality of their thoughts. Some of the topics have been frankly controversial, but there is no finer way to resolve questions than to state both sides so that the reader may weigh the merits of the arguments advanced in support of them. Moreover, if a reader is convinced of the rightness of his own point-of-view, he may find in the written statement of the opposition some argument which might have proved troublesome had he met with it in conversation without time to prepare an appropriate rebuttal.

The rich vein of interesting, original, valuable information about the profession is still scarcely tapped. The invitation is again extended in the apt words of President Flett, to "build up a literature about the profession."

May we express our deep appreciation to President Flett and the other officers of the INSTITUTE; to the members of the National Council; to Drs. Raymond E. Kirk, Hilton Ira Jones, and Walter J. Murphy of the Editorial Advisory Board; to the Contributing Editors; to Dr. Ed. Degering who supplies "Condensates", to C. P. Neidig, who reports "AIC Activities"; to Rudolph Seiden for "Chemical Books Abroad"; to the Chairmen and Officers of the Chapters, whose excellent programs have provided so many fine articles for publication; to every person who has contributed articles, reviews, news items, letters, suggestions, or other material, and to the advertisers whose support has been so helpful.

—Vera F. Kimball, *Editor*

AIC Activities

C. P. Neidig, F.A.I.C.

Los Angeles Chapter

Chairman, Dr. Romeo P. Allard
Vice Chairman, Chester H. Stephens
Secretary, Dr. Edwin A. Goldsmith
Treasurer, Wilfred McNeil Noble
Representative to National Council, Dr. L. F. Pierce

The Los Angeles Chapter met May third. The speaker was Dr. George W. Beadle, chairman of the Division of Biology at the California Institute of Technology, and his topic was "Recent Advances in Chemical Genetics." Dr. Beadle is world-famous for his genetics studies, and is recognized as the founder of the field of Chemical Genetics. He received the Lasker Award for 1950, the "Medical Oscar", from the American Public Health Association.

Chicago Chapter

Chairman, Bruce M. Bare
Chairman-elect, Dr. W. B. Hendrey
Vice Chairman, Dr. B. S. Friedman
Secretary-treasurer, Dr. Glen Hedrick
Representative to National Council, Dr. Gustav Egloff

The Chicago Chapter held an open meeting on April 27th. Dr. Charles C. Price III, F.A.I.C., head of the Department of Chemistry, University

of Notre Dame, presented a timely topic of interest to all, "The Scientist in Politics." This aroused quite an interesting question-and-answer and discussion period following the speaker's presentation. A short business meeting preceded the evening's program, during which the Nominating Committee submitted its selections for officers to be filled in the next election in June. Forty-eight people attended the meeting. The June meeting was scheduled to be held on June first, at the Western Society of Engineers' Building, Chicago. It will be the annual business meeting.

Washington Chapter

Chairman, Louis N. Markwood
Vice Chairman,
Elizabeth M. Hewston
Secretary, Paul E. Reichardt
Treasurer, Dr. R. C. Roark
Representative to National Council,
L. N. Markwood

The Washington Chapter held a luncheon meeting on March 7th, with thirty members in attendance. Dr. Frank Gonet of the U.S. Tariff Commission, recently returned from several months of European trade negotiations, gave a thumbnail sketch of his work and travels. Chairman Markwood was elected to represent the Chapter at the Annual Meeting at Niagara Falls, Ont.

On April 19th, another luncheon meeting was held with twenty members attending. The meeting had strong competition, as General MacArthur visited Washington that day. Officers were nominated for the coming year.

The Chapter had the pleasure of meeting Dr. and Mrs. Henry Tauber, of Chapel Hill, North Carolina. Dr. Tauber is a Washington Chapter member, but by reason of his remoteness from the metropolitan area had not been able to join us before.

The final meeting of the season will be held during the first week in June, at which time student medals will be presented to outstanding students from the area.

Pennsylvania Chapter

Chairman, Ronald J. Baird
Chairman-Elect, Adalbart Farkas
Secretary-Treasurer, John Staub
Representative to National Council,
Marcus Sittenfield

The Pennsylvania Chapter held an excellent meeting on May 3rd, with seventy in attendance. The speaker was Dr. N. B. Sommer of Jefferson Chemical Company, who spoke on "The Chemistry of Ethylene Oxide." His talk was most interesting and a lengthy discussion period followed.

AIC Student Medals were awarded to nine students from colleges and universities in the area, and they were honored at a dinner preceding the meeting. (The names of all student medalists will be published in the July CHEMIST.)

The new officers, elected at this meeting, are listed above.

New York Chapter

Chairman, Dr. Henry B. Hass

Vice chairman, Karl M. Herstein

Secretary-Treasurer, Guy A. Kirton

Representative to National Council, Dr. M. J. Kelley

The New York Chapter met May 24th at the Hotel Commodore, New York, N.Y., to honor Dr. Raymond E. Kirk, head, Department of Chemistry, and dean of the Graduate School, Polytechnic Institute of Brooklyn, New York, with the 1951 Honor Scroll, and to present student medals to eleven outstanding students from colleges in the area.

At a brief business meeting, the officers listed above were elected, and in addition, Dr. A. F. Guiteras and John Happel were elected councilors for three-year terms. Dr. Kenneth W. Newman was elected councilor for a two-year term. A large majority of the members present voted for the adoption of an amendment to the by-laws, which will provide for local chapter dues of $2.00 a year. Medals for achievement in scholarship, leadership and character, were presented to eleven senior students from colleges and universities in the area.

The Chapter's Honor Scroll for 1951 was then presented to Dr. Raymond E. Kirk.

Appointed: E. Scott Pattison as manager of the Glycerine Division and Fatty Acid Section of the Association of American Soap & Glycerine Producers, Inc., 295 Madison Ave., New York 17, N.Y. He was formerly executive vice president of the G. M. Basford Company.

New Senior Associate: Howard Berry, now with R. S. Aries & Associates, 400 Madison Avenue, New York, 17, N.Y., formerly vice president, treasurer, and director of Mathieson Chemical Corporation.

Appointed: Kenneth H. Klipstein, F.A.I.C., as deputy director of the Chemical Division, National Production Authority, U.S. Department of Commerce. He has been granted leave from his position as assistant general manager and head of the Technical Department, Calco Chemical Division, American Cyanamid Company, Bound Brook, N.J.

Testimonial Dinner: To honor Dr. Alexander Silverman, Hon. AIC, head of the chemistry department of the University of Pittsburgh, by the University, in the Faculty Club, June 13th. He will retire from teaching after forty-six years of service.

Featured: Crawford H. Greenewalt, F.A.I.C., president E. I. du Pont de Nemours & Company, on the front cover and within *Time,* April 16th.

Opportunities

Doris Eager, M.A.I.C.

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Age 26-35.

   This position will involve process development work on synthetic resins which have been or will be commercially marketed.

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Chemist: Knowledge of economics, statistics, able to determine chemical markets, feasibility of chemical processes. Familiar with market research procedures, sources of data and capable technical writer. Metropolitan New York. Up to 5 years experience. Salary commensurate. Box 63, THE CHEMIST.

Chemists Available

Industrial Chemist. Training manufacture textile chemicals; pharmaceuticals; organic chemicals. 15 years experience purchasing, cost calculations; trouble shooting; sales; supervisory capacity. Location open. Native born. Single. Age 38. Box 60, THE CHEMIST.

Market Research Trainee. B.S. Chemistry, 1948; graduate study in marketing, chemistry. Some general experience. Single. Age 28. Veteran. Box 62 THE CHEMIST.

Patent Attorney. Ph.D. Columbia University, 1937, registered before U.S. Patent Office, over 5 years patent experience, plus 5 years industrial experience. Age 43, married and draft-exempt. Field of special knowledge pulp and paper, petroleum, plastics, and synthetic paints. Box 64. THE CHEMIST.

New Company: Monsanto S. A. Produtos Quimicos e Plasticos, formed by Monsanto and a group of Brazilian interests, to construct plants, probably in the vicinity of Sao Paulo, for the manufacture of vinyl chloride monomer and Ultron polyvinyl chloride resins and compounds.

Change of Name: Standard Stoker Company to Read Standard Corporation, York, Pennsylvania. There is no change in ownership, management or personnel. Operations are now separated into the Bakery-Chemical Division and the Blower-Stoker Division.

Co-sponsor: Owens-Corning Fiberglas Corporation, of the Southwest Research Institute's Housing Research Foundation.

Condensates

Ed. F. Degering, F.A.I.C.

The Miner Laboratories

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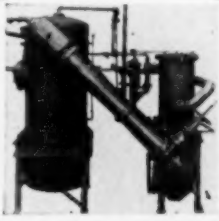

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